Concrete

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Porous Concrete Has Its Uses

By Harvey Whipple
Editor Concrete

THE thing, above all else, that makes life interesting, coloring up the drab edges of what would otherwise be a dull job, is the exchange of old ideas for new ones. Of course we always resist the new ideas—"it can't be done," and all that—but sooner or later we grab hold of them, some of them, and get a "thrill" as the schoolgirl says.

It has been a first principle that concrete shall be dense. We have gone to no end of pains to learn the best and most economical means of making it that way, because we came to understand that density and strength keep pretty close company; that density is the best means of keeping at bay a hundred and one destructive agencies that lurk in the earth and in water and in the air above the earth. We have got a good hold of that idea. It influences every batch of concrete we make. But if we can keep our hold of that idea with one hand and sieze another we may in time come to juggle two to better purpose.

Turn from the thought of a concrete whose particles are held in the closest possible unity, to a concrete like a popcorn ball or a piece of Swiss cheese. We sacrifice strength and gain insulation. A concrete that is of *almost* maximum density and not quite, probably isn't permeable but it is to some extent absorptive. Capillarity gets in its work. A concrete in which the voids are larger loses capillarity, *sucks* little or no moisture through and when properly sealed up outside by a waterproof stucco or other means, becomes a better barrier against the weather than a concrete that is much more dense.

This isn't a new idea. More than a dozen years ago Concrete published a letter from an Australian builder who proposed making his house weatherproof by going directly contrary to the accepted practice—getting a maximum of porosity consistent with requisite strength. While the idea isn't new the development of it gives us "gasconcrete" or "expanded concrete." A highly porous concrete can be made mechanically. As made chemically the reaction between an alkaline metal and water when mixed with cement and the other ingredients of concrete, releases hydrogen which blows the concrete full of cells as the yeast does in the rising dough.

So, instead of lining our best concrete houses with sheet cork for a more perfect insulation, we may come to introduce those same valuable cells of imprisoned air into our concrete and effect the insulation in the concrete itself.

We lose strength in our material but strength is a quality we can learn to measure by its uses. We must have strength *enough.* We must also avoid that friability to which lean concretes are subject. Friability, however, is to a considerable extent adduced by weather action, water and frost. If then we can maintain a skin density which will keep out the destructive agencies; behind that skin provide sufficient strength for the purpose and at the same time introduce the cellular structure which insures much good insulation, concrete will be just that much more useful.

We have been preparing for all this through pumice concrete, slag concrete, burned-clay aggregate concrete, coke-breeze concrete, cinder concrete. Cinder concrete goes a long way in the desired direction. It merely needs closer control. However the result is best obtained, by control of the mix we can safely trade some strength for better insulation.

Fineness

(Editorial from *Concrete and Constructional Engineering,* London, England)

THE days when the fine grinding of cement can be used as a "talking point" by cement salesmen are coming to an end. It is being more and more recognized that the only desiderata of cement are strength, endurance, and suitable setting qualities, and so long as these are provided by the manufacturer the means by which they are obtained—of which find grinding is only one—are of little interest to the buyer. There is, of course, a definite requirement for fineness in most cement specifications, but it should be remembered that the scientific development of cement manufacture is recent and until lately it has been desirable for standard specifications for cement to safeguard the buyer by ensuring that the cement shall be produced by certain well-tried methods proved by experience to be safe and reliable. The early days of cement manufacture had shown that coarsely-ground cement was liable to be weak and unsound, and consequently fine grinding was stipulated in specifications. Both manufacture and specifications were, in fact, empirical. With increasing knowledge it is probable that specifications will abandon all attempts to regulater the process of manufacture, leaving the producer a free hand to obtain the specified strength and stability in the manner most convenient to him.

It would therefore be a retrograde step to adopt the suggestion given prominence by one of our engineering contemporaries that the present method of ascertaining the fineness of cement by sieve tests should be superseded by the use of an apparatus for determining the proportion of flour in the cement. The objections raised to the sieve test are that it is unreliable because of the difficulty of obtaining standard and consistent wire mesh for sieves and that it fails to discriminate between the active and inert particles in a cement. It is suggested that an appliance such as the flourometer should be adopted, and cement specifications would presumably require a minimum proportion of flour.

Such a recommendation as this is objectionable primarily because it constitutes a further interference with the cement manufacturer, or, at the best, substitutes one means of dictation for another; and such interference is becoming unnecessary. There are, however, other reasons why the flour test should not be introduced into cement specifications, and one of these illustrates the disadvantages occurring when specifications are empirical. The flour test is one in which the fine and coarse particles in cement are separated by elutriation either by air or by a suitable liquid. By passing a current of air or liquid through a given quantity of cement for a certain period the fine particles of flour are carried away and the coarse particles remain and can be weighed to determine their proportion in relation to the whole. It is only the flour that has cementitious properties at early dates; the coarser particles do not contribute their quota to the strength of cement until later, and indeed some of the larger grains may be permanently inert. Hence a cement with a low proportion of flour is weak at early dates, and, conversely, when the proportion of flour is high the cement generally develops its strength rapidly. A cement containing 100% flour would probably reach its maximum strength when neat at seven days, and by so doing would fail to comply with the British standard specification which requires a proportionate increase from seven to 28 days. Hence our contemporary's desire for more flour in cement is incompatible with the specification requirement. The origin of this stipulation for increase in neat tensile tests from seven to 28 days dates from the time when cement was crudely manufactured, and any failure to grow in strength was frequently a sign of impending disintegration. Although the test still remains, the necessity for it has disappeared because the stability of cement can now be ascertained by quicker and more adequate tests.

It has already been mentioned that fine grinding is only one of the means of obtaining strength and stability in cement, and to describe the fineness test as "one of the most important and necessary" is an undesirable emphasis. The advantages obtainable from fine grinding of cement can also be produced by changes in chemical composition, by harder burning, or by finer grinding and more intimate mixing of the raw materials. The manufacturer selects from these possibilities those which best serve his purpose to produce a cement of given strength and stability, and it would be as illogical for the buyer to demand an extra percentage of lime or alumina in the cement as it is to insist upon an extra percentage of flour. The tests for strength and stability of cement should be as stringent as the best brands can stand, but the manufacturer cannot give the best and most economical results if he is unduly restricted in methods of manufacture. We take leave to doubt whether "the flour question would be a vital one" in connection with the grouting work of St. Paul's Cathedral. If the cracks and interstices in the rubble within the piers were of such dimensions that grains of cement retained on a sieve of 180 meshes per linear inch could not enter, then the necessity for grouting could hardly have arisen, and when dealing with neat cement it must be remembered that the finer the cement the greater is the proportion of water required to produce a given consistency, and the greater the proportion of water the greater is the tendency to contraction.

Up-Build or Up-Keep

By Allen Brett

CLEVELAND

It is an axiom among road builders that a road is no better than its foundation. On the other hand, the average driver is rather positive that a road is no better than its surface. As for the highway engineer himself, his job is to get, for the money spent, the maximum value in both foundation and surface. In this connection the following approach to the problem, suggested a good many years ago, may merit consideration.

The suggested solution approaches the problem with the fact that, other things being equal in a road improvement program, the present road structure, the well beaten gravel, the ravelled brick or macadam, the gravel or whatever it is, should be in most cases the best foundation for the new road. Some trimming-up may be necessary, but why take a fairly good road or at least a very well-packed foundation, put a steam shovel into it, tear it out, wreck what should be a fairly good foundation, to provide a relatively poor base for a new foundation, which in a comparatively short time will also fail and be torn out.

Why not build the new road on top of the old one? Impossible of course on account of the grades! But why? Why not *anticipate grades*? And so the idea shaped itself somewhat as follows:

Suppose in facing the road program of a typical county, or any of the national highway projects, we could anticipate and establish the grade for 1950. Would it not be feasible to set the 1925 grade at 24 in. or 18 in. or 30 in. below the 1950 grade and build a good road to that grade? Best current practice can be followed in up-keep and the surface kept in the best repair possible, but roads do wear out and at some time in the future the surface will have ravelled to the extent that it is cheaper at that time to surface the entire road than to keep patching the surface. When that time is reached, place a new surface, say 4 in. to 6 in. thick and start in on careful maintenance of that.

Repeat the cycle as often as necessary, but it is apparent that the better the foundation, the better the surface wears. In a program such as this, it will pay to spend money for the best surface materials available. Such surfaces will keep fit under reasonable maintenance for longer and longer periods until the cycle stretches out to the point where we really have a permanent roadway, 2 to 4 ft. thick, more if necessary, a real Roman Road.

There are of course disadvantages to a construction program along the lines suggested. There will be trouble at intersections, difficulty with drainage, and shoulders and curbs will be hard to handle. Definite offsets to this would be the fact that all new surface work could be handled more quickly, necessitating shorter detours, and more constant use of the road.

The basic idea behind the suggestion is that the elevation of a road, its height above datum level, is not important to the driver. The Lincoln Highway could be 18 in. below its present grades, or run along in 1950 18 in above where it is now, and the average driver or the taxpayer would not care much so long as the surface is good, detours are few and taxes are low.

Why not make the road the important thing and not the elevation? Let the elevation work for the road instead of the road working for the elevation. Wouldn't we rather have a 3-ft. road at the exact elevation in 1950 than to have built five 8-in. roads to that elevation in the next 25 years? The way traffic is increasing our roads will have to be about 3 ft. thick so why not start now?

Isn't it less expensive and a whole lot better to up-build a road than to up-keep it?

Foundations Repaired with Precast Units

Supporting Structure of a Steam Plant While in Operation

By C. P. Dunn
Designing Engineer, Portland Electric Power Co.

A foundation structure built up of precast concrete members to replace supporting wood piles immediately beneath the concrete mat in a power generating station for the Portland Electric Power Co., was recently successfully completed without interruption of service of the power plant equipment.

The Portland Electric Power Company's steam station "L," located near the center of the City of Portland, Oregon, on the bank of the Willamette River, is used as an auxiliary to the company's hydro stations during the low water season in summer and fall, and as a peak carrying plant during the months of heaviest load in December and January. The plant was built in 1910, the present installed capacity being 23,500 k. w., made up of one 12,500 k. w. turbine one 3,000 k. w. turbine, one 6,000 k. w. turbine, and one 2,000 k. w. reciprocating engine. There are twelve boilers, eight of which are within the original building, four being a separate installation.

The fuel ordinarily used is sawmill refuse, oil burning equipment being installed for emergency use.

The station, 135 ft. x 165 ft. in plan, was built on a reinforced concrete mat 3 ft. 0 in. thick, the mat being supported by Douglas fir piles spaced 3 ft. 0 in. centers both ways over the entire area. The ground was graded off to elevation +14.0, and the piles cut off at elevation +14.5, leaving 6 in. of pile head bedded in the mat which was poured on the ground at elevation +14.0, the top of the mat being elevation +17.0. Extreme low water of the river is elevation 0.0 and extreme high water is elevation +33.0, the normal stage being in a range from elevation +5.0 to +8.0.

Several buildings in the City of Portland have the foundation piles cut off at 14.5 or higher the moisture in the ground preventing decay. The piles under Station "L" were moist at all times up to elevation 14.0, but decay occurred at the extreme top of the piles, due to the combination of moisture and heat, and to the fact that the ground settled away from the mat about two inches.

In the fall of 1923, the decay of the top of the piles had reached the point where there was a possibility of serious settlement occurring, and after a study of several possible methods, it was decided to cut the piles off at elevation 0.0

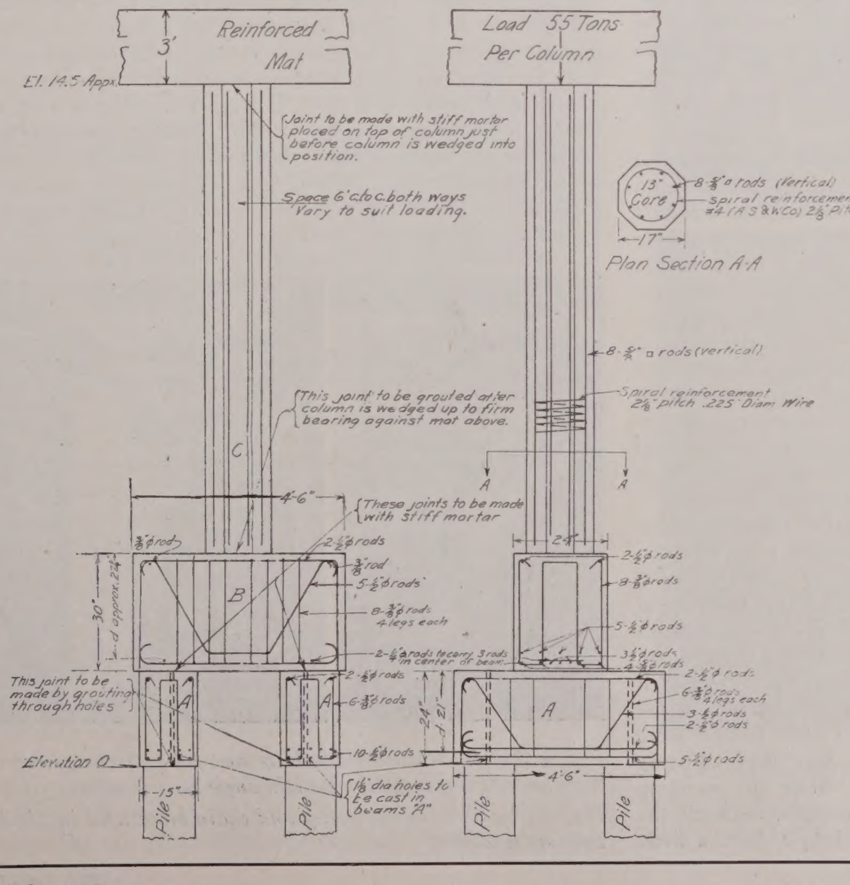
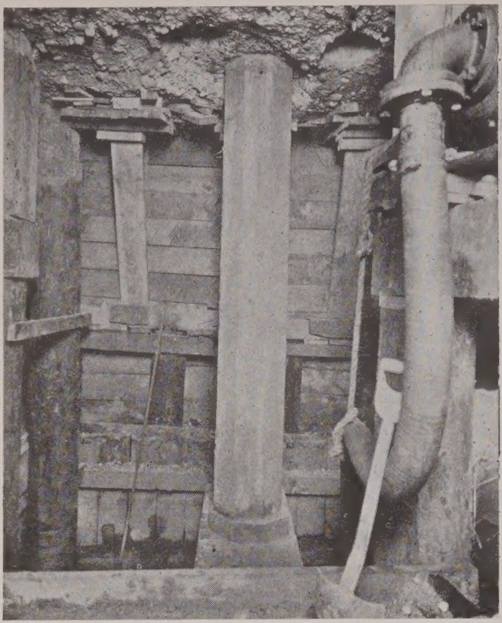

Reinforced Mat
3'
El. 14.5 Appx.
Load 55 Tons Per Column
Joint to be made with stiff mortar placed on top of column just before column is wedged into position.
Space 6' c. to c. both ways Vary to suit loading.
13" Core
8-5/8" □ rods (Vertical)
spiral reinforcement #4 (A S & W Co) 2 1/8" Pitch
17"
Plan Section A-A
8-5/8" □ rods (vertical)
This joint to be grouted after column is wedged up to firm bearing against mat above.
Spiral reinforcement 2 1/8" pitch .225" Diam Wire
C
A
A
4'-6"
These joints to be made with stiff mortar
3/8" φ rod
2-1/2" φ rods
3/8" rod
5-1/2" φ rods
B
30"
d approx. 22 1/2"
8-3/8" φ rods 4 legs each
2-1/2" φ rods to carry 3 rods in center of beam
24"
2-1/2" φ rods
8-3/8" φ rods
5-1/2" φ rods
3 1/2" φ rods
4-5/8" φ rods
This joint to be made by grouting through holes
A
A
2-1/2" φ rods
6-3/8" φ rods
24"
d 21"
A
2-1/2" φ rods
6-3/8" φ rods 4 legs each
3-1/2" φ rods
2-1/2" φ rods
10-1/2" φ rods
Elevation 0
5-1/2" φ rods
15"
1 1/8" dia holes to be cast in beams "A"
4'-6"
Pile
Pile
Pile
Pile

Fig. 1—Detailed sketch showing arrangement of precast blocks and columns used to replace tops of foundation piles



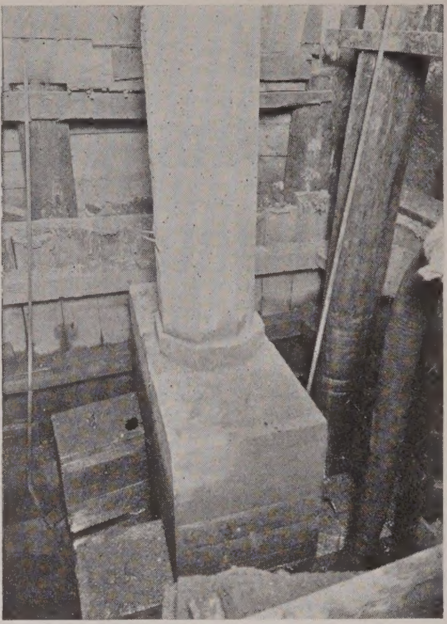


Fig. 2 (Left)—One of the precast columns supporting the concrete mat

Fig. 3 (Right)—Base of column and precast blocks arranged to distribute column load to four piles

and build up the 14 ft. between 0.0 and the bottom of the mat with precast concrete structure. The use of precast members was the only way the work could have been accomplished in one low water season from July to November because, in order to make rapid progress with the work it was necessary to be able to load the columns immediately after they were placed, so that adjacent piles could be removed. This precluded the possibility of brick piers or any scheme which would involve pouring concrete in place. The possibility of cutting the piles off at about elevation +6.0 was discussed. The procedure would have involved protecting the individual piles between elevation +6.0 and 0.0 with a 3 in. concrete shell, which would have been placed by jetting down a sheet metal casing 6 in. greater in diameter than the pile. This idea was abandoned because it appeared to be more expensive than the one finally adopted, and because there was considerable uncertainty as to the difficulties that might be encountered in jetting the casings down through coarse gravel.

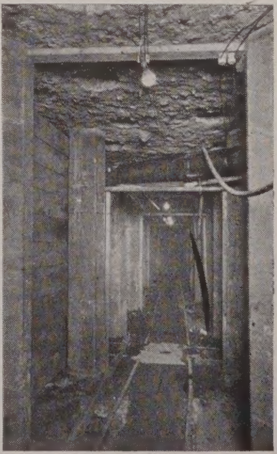
The idea finally adopted was to build up a structure of precast blocks and columns in such a way that one column replaces four piles, the total number of piles under the building (some 2500) being replaced by about 625 structures made according to drawing reproduced in Fig. 1.

The maximum load per pile is about 14 tons, making a load of 56 tons on one of the 17 in. octagonal spirally reinforced columns. While the load in some parts of the building was considerably lighter than 56 tons per column, no economy could have been effected by making more than one type of precast structure, and on account of the possibility of additional machinery installation in the future it was deemed inadvisable to omit any of the columns, so it was decided to make the entire supporting structure uniform throughout.

After the piles were cut off at elevation 0.0, they were capped in pairs with precast beams, 15 in. x 24 in. x 4 ft. 6 in.; beam *B* was laid across a pair of beams *A*, and column *C* swung into place on top of beam *B*. The joints between *A* and the pile heads, and between *B* and *A* were made with 1:1 stiff mortar. The columns were cast about 1½ in. short, about ½ in. of 1:1 mortar being placed on the top of each column as it was hoisted into place. At the bottom of the column two pairs of 3 in. x 1 in. x 16 in. steel wedges were used to wedge the column up against the mat the load being immediately taken by the structure. After the wedging was completed, the space around the wedges, between the column and beam *B* was filled with grout, a form a little larger than the column and about 4 in. high being used. This collar of grout can be seen in Figures 2 and 3.

It was necessary for the work to proceed very carefully, because a slight settlement of any part of the foundation would have made it impossible to keep the steam turbines in operation. Careful precise levels were run daily, in order that settlement might be immediately observed and stopped. It is greatly to the credit of the construction men that no settlement of any consequence occurred.

At the beginning of the work a transverse tunnel was excavated about midway of the building, with an elevator in a shaft on the end of the transverse tunnel toward the river. One row of piles was removed and a 2-ft. gauge track installed. As the excavation proceeded, the decayed piles were temporarily cut off at about elevation +9.0 and the load taken on square timbers. This practice was followed throughout the work in order to make it possible to keep the excavation well ahead of the placing of the concrete without incurring the danger of settlement. The concrete structures were placed consecutively in rows across the building, working both ways from the first tunnel, only four piles being removed at a time, the load being immediately taken by the new structure before the adjacent four piles were cut off.



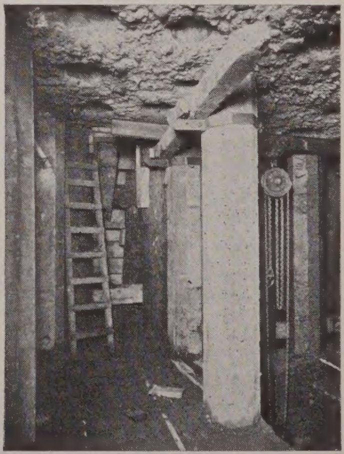
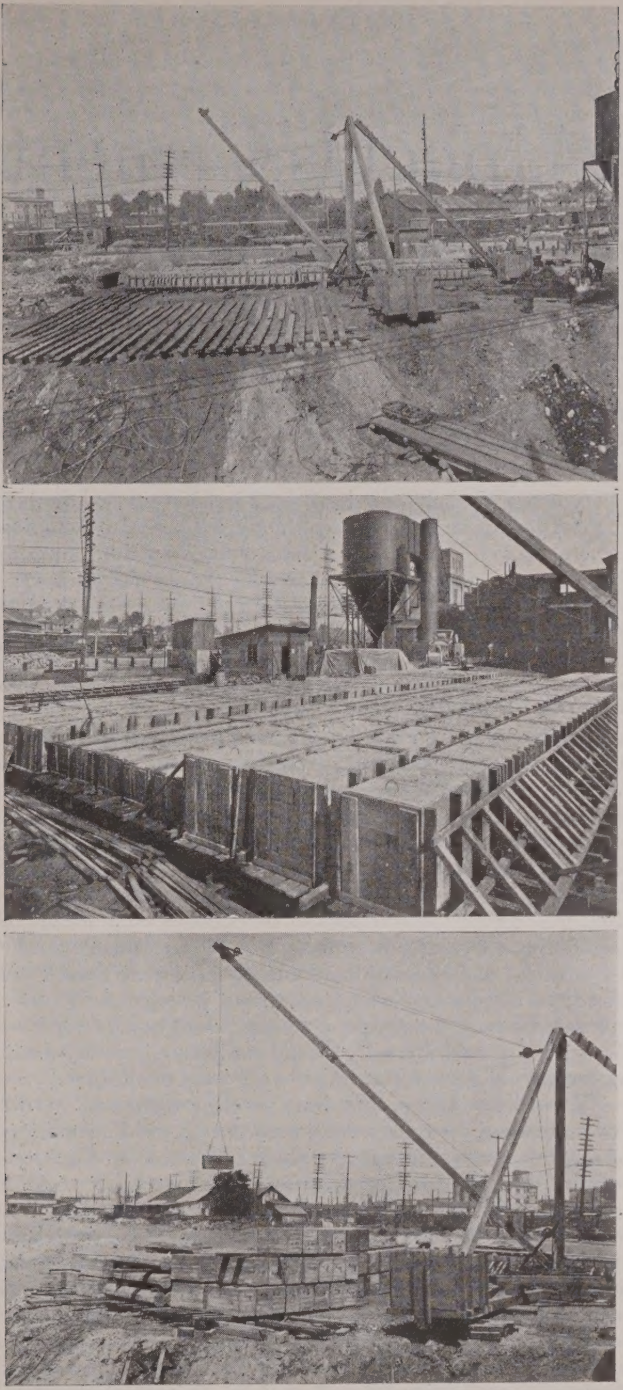


Fig. 4 (Left)—Main drift looking east from discharge tunnel. Turntable for turning cars at right angle turn is shown

Fig. 5 (Right)—I-beam trolley and chain block used in placing concrete members



Figs. 6-8—Views of yard where precast members were made. The derrick was used to transfer the blocks and columns to the cars

As the work progressed, the excavated material was backfilled around the completed work. It is believed that this backfill around the columns, which will be compacted by water will provide all necessary resistance to swaying of the structure, but as an additional precaution some 500 lin. ft. of web walls have been placed between the columns for sway-bracing. These walls are 5 ft. high and 8 in. thick, placed between elevation 0.0 and +5.0 reinforced with ½-in. round bars 12-in. centers both ways.

Before the concrete structures are placed, all piles are tested to about 20 tons with a hydraulic jack.

Under the boiler room the piles were in general decayed about the same as they were under the engine room, being soft for a few inches at the top, and sound below. However, under the ash pits the tops of the piles were charred away, leaving the concrete mat under the ash pit almost unsupported. There is about two feet of earth fill between the bottom of the ash pit and the top of the mat and the mat is 3 ft. thick. The normal ash pit temperature is about 700° F.

The 2-ft. gauge track was extended in all directions as the work progressed, turntables being installed at several points where right angle turns were necessary as shown in Fig. 4. The muck and the concrete members were handled on small cars propelled by hand. The concrete members were set in place by a chain block on an I-beam trolley, Fig. 5. The I-beam could be easily shifted around and supported from either finished columns or undisturbed piles by means of clamps.

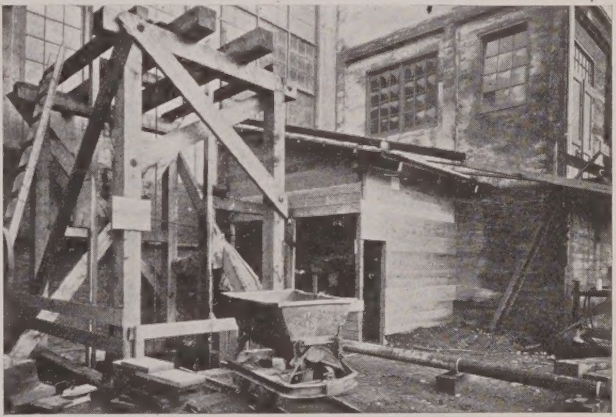
The material was cast in the yard shown in Figs. 6, 7 and 8 and handled with a derrick to storage or to cars.

Concrete for the columns was mixed in the proportions 1:1½:3 and in the blocks or beams, 1:2:4. The columns were reinforced with eight ⅝-in. square vertical rods with spiral reinforcement of No. 4 A. S. and W. Co., 2⅛-in. pitch.

During a greater part of the time the work was carried on by three shifts of workmen. At one time there were more than 200 men at work. The entire project was finished without interruption of production. Station "L" is one of the main sources of power supply of the Portland Eelectric Power Co., and is used largely for operating downtown trolley lines.

Although the work was in a class considered hazardous, there was no loss of time from accidents. There were no serious injuries to any of the workmen.

The construction work was done by the Raymond Concrete Pile Co., the men in direct charge of the job were G. W. Mills, Wm. Bailey and B. M. Begg.



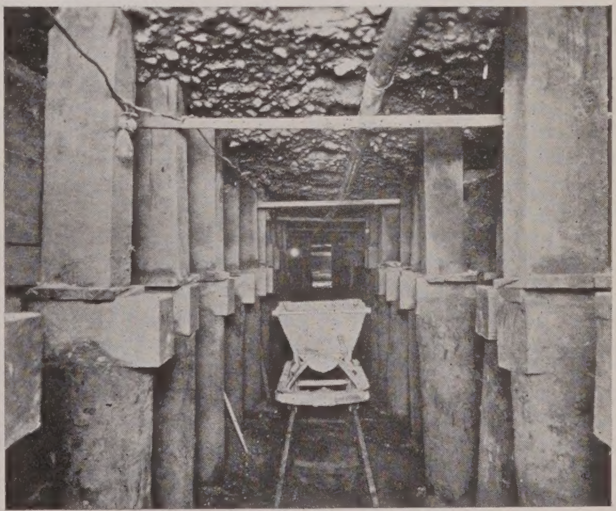


Fig. 9—Top of construction shaft

Fig. 10—Interior view of tunnel used to remove dirt before precast members were placed

U. S. Supreme Court Upholds Cement Trade Association Activities

By I. D. Foos

WASHINGTON, D. C.

Recognition of the trade association as a legitimate form of organization by members of the same industry or trade for gaining wider and more scientific knowledge of their business conditions was given by the Supreme Court of the United States on June 2 in opinions on two test cases prosecuted by the Government involving the operations of the Cement Manufacturers Protective Association and the Maple Flooring Manufacturers Association. Uncertainty as to the legal status of association activities definitely was removed by the court's dictum. The majority opinion was delivered by Associate Justice Stone, former Attorney General, and reversed in both cases the decisions of lower courts. Chief Justice Taft and Associate Justices McReynolds and Sanford dissented.

Incorporated in Justice Stone's opinion was a general discussion of trade association practices followed by a pronouncement that such organizations are not engaged in unlawful restraint of trade when they openly and fairly gather and disseminate current statistical information, nor when they meet and discuss such information without reaching or attempting to reach any agreement with respect to prices, production or restraining competition.

"The natural effect of the acquisition of wider and more scientific knowledge of business conditions on the minds of the individuals engaged in commerce and its consequent effect in stabilizing production and price can hardly be deemed a restraint of commerce," said Justice Stone, "or if so, it can not, we think, be said to be an unreasonable restraint or in any respect unlawful."

Justice Stone stated that the court was justified in previous cases in sustaining the Government's contention because the statistical service rendered was made the basis of concerted action for the control of production and price by the Armstrong Bureau of Related Industries and the American Hardwood Manufacturers Association, the defendant organizations. Justice McReynolds, in his dissenting opinion, contended that the court should adhere to the precedent established in those cases because, he said, the Maple Flooring Manufacturers Association and the Cement Manufacturers Protective Association were "definite and unusual combinations and agreements whereby each is obligated to reveal to confederates the intimate details of his business and is restricted in his freedom of action."

Justice McReynolds declared that "carefully developed plans to cut down normal competition in interstate trade and commerce" had been adopted by the two associations "to defeat the policy of the law without subjecting themselves to punishment. It seems to me," he continued, "that ordinary knowledge of human nature and of the impelling force of greed ought to permit no serious doubt concerning the ultimate outcome of the arrangements. We may confidently expect the destruction of that kind of competition long relied upon by the public for establishment of fair prices and to preserve which the anti-trust act was passed."

Chief Justice Taft and Associate Justice Sanford filed a joint dissent in which they stated that the two cases, in their judgment, squared with the hardwood and linseed oil cases, in which the Supreme Court held that the American Hardwood Manufacturers Association and the Armstrong Bureau of Related Industries were unlawful combinations in restraint of trade.

Trade associations now have a clear definition of the law and can govern themselves accordingly, according to Attorney General Sargent. "These decisions make it plain," he said, "that the mere collection and dissemination by a trade association of statistics relating to prices on past transactions, production, stocks in hand and sales is not in and of itself illegal. Both the cement and maple flooring associations maintained an elaborate system for gathering and distributing such statistics. The court plainly decided these cases against the Government upon the ground that the records did not disclose any or sufficient evidence of an agreement between the members to make use of the statistics in fixing prices curtailing production or otherwise restraining trade.

The court did not overrule but expressly distinguished the former decisions in the Hardwood Lumber and Linseed Oil cases, so that the Sherman law remains effective as to associations which may use a statistical service as a mere means of facilitating the fixing of prices, etc. by agreement. The Department of Justice will continue to be alert to detect and prosecute associations whose operations go beyond the mere dissemination of knowledge, now sanctioned by the Supreme Court, and actually result in combinations, conspiracies and agreements in restraint of trade in violation of the law.

"Trade associations now have a clear definition of the law and can govern themselves accordingly within the limits of these decisions and not operate in agreement to the detriment of the public and in violation of the law."

A few days prior to the Supreme Court's decisions it was learned that the Department of Justice, at the direction of the Attorney General and upon request, will advise trade associations on the legality of their activities. The Department will review any projected program that is voluntarily submitted by an association for an informal opinion on whether the Department considers the plan or any of its features as trespassing beyond the law. If it develops subsequently that the association has diverted a plan legal in itself to illegal purposes, the Department reserves the right to prosecute.

The new Attorney General has assumed good rather than evil intent on the part of business. He has evinced his willingness to attempt to reconcile trade association activities and the law out of court by acting as the counselor rather than the prosecutor of business to the extent that the conduct of the associations warrant him in so doing. In effect, he is seeking to encourage rather than discourage associational activity within the limitations imposed by statute. By the Supreme Court's decision and the moderation of Mr. Sargent, the policies of the Departments of Justice and Commerce have been harmonized, and the line of demarcation between the associations engaged in legitimate pursuits and those which are using association methods to accomplish illegal ends will be clear in the future.

Following is a summary of the court decree:

The Opinion of the Court

The case decided by the Supreme Court was an appeal from a final decree of the District Court for the Southern District of New York granting a perpetual injunction in a proceeding brought by the United States under the Sherman Act. The defendants were the Cement Manufacturers Protective Association, four individuals, the officers of the association and nineteen corporations, members of the association engaged in manufacturing and shipping cement in interstate commerce. The petition filed on June 30, 1921, alleged restraint of interstate commerce and after final hearing the District Court entered its decree enjoining the continuance of the Cement Manufacturers Protective Association and enjoined it and the several defendants from engaging in the following activities through which it was alleged the prices and production of cement were controlled within the territory served:

(1) The use of "specific job contracts" for future delivery of cement, accompanied by a system of reports and trade espionage having as its objective the restriction of deliveries of cement under those contracts.

(2) Compiling and distributing, among the members, freight rate books which give the rate of freight from arbitrary basing points to numerous points of delivery within the territorial area served by the several defendants.

(3) Exchange of information concerning credits.

(4) Activities of the Association at its meetings.

Important points referred to by Justice Stone in his opinion included "specific job contracts"; the association freight rate book; exchange of information concerning credits; meetings and legal consequence of association activities.

Cement is referred to as a thoroughly standardized product manufactured by the defendant corporations, from 60% to 65% of the total product of the defendant corporations being sold to the general trade for immediate use. Of this amount, approximately ⅔ is sold to dealers who are allowed a differential from the sales price to the retail trade.

The Government, Justice Stone stated, asserts that uniformity of prices and limitations of production are necessary results of these activities, but "it does not, however, charge any agreement or understanding between defendants placing limitations on either prices or production. The evidence does not establish that prices were excessive or unreasonable and the District Court found "as compared with the rise of prices of other basic commodities, it is possible to say that the quotations of cement advanced less than the others." The Court also found that competition has not been destroyed by the association and that upon many occasions the defendants were active in endeavoring to take business from companies associated with them."

SPECIFIC JOB CONTRACTS

Relative to specific job contracts the opinion of the Court includes the following:

We do not understand the Government to contend that the use of specific job contracts by defendants or that their use generally by the trade is the result of any agreement or understanding or in itself constitutes any violation of the Sherman Law. It is contended that the violation arises rather from the cooperation among the several defendants in acquiring and distributing information with reference to specific job contracts and the effect of the dissemination of that information on the trade, to which reference will now be made.

The specific job contract is a form of contract in common use by manufacturers of cement whereby cement is sold for future delivery for use in a specific piece of construction which is described in the contract. As was stated in the opinion of the court below, they are contracts "whereby a manufacturer is to deliver in the future, cement to be used in a specific piece of work, such as a particular building or road, and the obligation is that the manufacturer shall furnish and the contractor shall take only such cement as is required for or used for the specific purpose." These contracts have, by universal practice, been treated by cement manufacturers as, in effect, free options customarily made and acted upon on the understanding that the purchaser is to pay nothing until after the delivery of the cement to him; that he is not obliged in any event to take the cement contracted for unless he chooses to; that he is not held to the price named in the contract in the event of a decline in the market price; whereas the manufacturer may be held to the contract price if the market advances and may be held for the delivery of the full amount of cement required for the completion of the particular piece of construction described in the contract. The practical effect and operation of the specific job contract therefore is to enable contractors who are bidding upon construction work to secure a call or option for the cement required for the completion of that particular job at a price which may not be increased, but may be reduced if the market declines. It enables contractors to bid for future construction work with the assurance that the requisite cement will be available at a definitely ascertained maximum price.

In view of the option features of the contract referred to, the contractor is involved in no business risk if he enter into several specific job contracts with several manufacturers for the delivery of cement for a single specific job. The manufacturer, however, is under no moral or legal obligation to supply cement except such as is required for the specific job. If, therefore, the contractor takes advantage of his position and of the peculiar form of the specific job contracts, as modified by the custom of the trade, to secure deliveries from each of several manufacturers of the full amount of cement required for the particular job, he in effect secures the future delivery of cement not required for the particular job, which he is not entitled to receive, which the manufacturer is under no legal or moral obligation to deliver and which presumably he would not deliver if he had information that it was not to be used in accordance with his contract. The activities of the defendants complained of are directed toward securing this information and communicating it to members and thus placing them in a position to prevent contractors from securing future deliveries of cement which they are not entitled to receive under their specific job contracts, and which experience shows they endeavor to procure especially in a rising market.

The Government does not contend that the activities of the association with respect to the specific job contracts diminished the number of such contracts, or that they diminished in any way the obligations of the members of the Association upon such contracts. There is, however, abundant evidence to show that there were actual cancellations of deliveries on the ground that contractors were not entitled under the terms of their coontracts, to receive such deliveries. In 1920, of the 1392 contracts investigated and found to be "padded" to the extent of more than 3,500,000 barrels of cement, 978 were partially cancelled to the extent of 2,014, 653 barrels.

THE ASSOCIATION FREIGHT RATE BOOK

The custom in the cement trade of selling cement at a delivered price which includes the mill price, the price of bags and freight charges was an established trade practice before the organization of the defendant organization, according to Justice Stone.

The freight rates contained in the freight rate book are compiled rom the official tariffs and translated from the rate per ton of the official tariffs into the rate per barrel of 380 pounds, the unit for the sale of cement. Similar lists of freight rates embracing substantially the same subject matter were prepared and used by the individual manufacturers before the organization of the defendant association.

The Association freight rate book took the place of previous separate publications by individual manufacturers, with a consequent saving of money and increase of accuracy and a more thorough and continuous checking of rates. The basing points from which freight rates were calculated were not selected by the Association, but were the same as those appearing in prior books published by individuals before the publication of the Association freight rate book. The basing points are points of actual shipment from which the larger proportion of the cement in a given locality in which cement is manufactured is actually shipped. The rates published are the actual rates omitting fractions of cents between the basing points and actual points of delivery.

Manufacturers customarily and for the purpose of the convenient conduct of their business, maintain a uniform base or factory price, so far as the customers of the individual manufacturer are concerned. That is to say the business is conducted on a "one-price" basis. In order, however, to determine the delivered price, there must be added to the factory price of a given manufacturer, the cost of transportation to the point of delivery. Prompt quotations of a delivered price therefore involves the ability to carry out promptly the mechanical process of adding to the mill price, the cost of transportation to the point of delivery. Lists of freight rates, in convenient and readily available form, are therefore necessary adjuncts to the quotation of delivery prices for cement.

The use of basing points for the purpose of computing freight rates appears not to have been the result of any collective activity on the part of defendants or cement manufacturers generally, nor were they arbitrarily selected. Their use is rather the natural result of the development of the business within certain defined geographical areas. When a manufacturer establishes his factory at a given point of production and sells his product in a territory which is contiguous freightwise to his factory, other mills established in the vicinity and serving the same territory, in order to compete in that territory, must either secure a like freight rate or they must sell at a mill price which will permit them to deliver cement at a price which will enable them to compete with the mill or mills located at the basing point which is the principal point of production in the territory which is contiguous in point of freight rate to the basing point.

Whether or not a blanket freight rate is adopted, the freight rate from the basing point is an essential element in making a delivered price, since selling by any particular manufacturer at the lowest of the delivered prices computed from several basing points is a necessary procedure in computing the sale of cement, the Justice stated, adding that the freight rate book enables the manufacturer to determine at once the freight differential which he must offset in his mill price in order to compete with other manufacturers serving any other given territory.

Exchange of Information Concerning Credits

The Justice cited that there were never any comments concerning names appearing on the list of delinquent debtors. The Government neither charged nor proved that there was any agreement with respect to the persons to whom or conditions under which credit should be extended. "The evidence falls far short of establishing any understanding on the basis of which credit was to be extended to customers or that any cooperation resulted from the distribution of this information or that there were any consequences from it other than such as would naturally ensue from the exercise of the individual judgment of manufacturers in determining, on the basis of available information, whether to extend credit or to require cash or security from any given customer."

Meetings

With reference to suggestions and discussions of individuals at meetings relative to such subjects as return of bags, and bag reports, discounts, and the use of trade acceptances where customers desired more than the customary thirty days' discount, Justice Stone stated that either no action was taken, or action was taken adverse to the suggestions made. "There is no evidence that any agreement was reached affecting any of the matters discussed; nor does the government point specifically to any uniformity of trade practice or custom followed, which is urged as even inferentially the result of activities at meetings."

Referring to the legal consequence of the defendants' activities, the Court did not see in the activities with respect to specific job contracts any basis for the contention that they constitute an unlawful restraint of commerce.

> Unless the provisions in the contract are waived by the manufacturer, demand for and receipt of such deliveries by the contractor would be a fraud on the manufacturer and in our view the gathering and dissemination of information which will enable sellers to prevent the perpetration of fraud upon them, which information they are free to act upon or not as they choose, cannot be held to be an unlawful restraint upon commerce, even though in the ordinary course of business most sellers would act on the information and refuse to make deliveries for which they were not legally bound. * * * * But for reasons stated more at length in our opinion in *United States* v. *Maple Flooring Association, supra*, we cannot regard the procuring and dissemination of information which tends to prevent the procuring of fraudulent contracts or to prevent the fraudulent securing of deliveries of merchandise on the pretense that the seller is bound to deliver it by his contract, as an unlawful restraint of trade even though such information be gathered and disseminated by those who are engaged in the trade or business principally concerned.
>
> Nor for the reasons stated, can we regard the gathering and reporting of information, through the cooperation of the defendants in this case, with reference to production, price of cement in actual closed specific job contracts and of transportation costs from chief points of production in the cement trade, as an unlawful restraint of commerce; even though it be assumed that the result of the gathering and reporting of such information tends to bring about uniformity in price.

Citing that agreements or understanding among competitors for the maintenance of uniform prices are unlawful and may be enjoined, the Justice stated that the Government does not rely on any agreement or understanding for price maintenance. It relies rather upon the necessary leveling effect upon prices of knowledge disseminated among sellers as to some of the important factors which enter into the price. Conceding that there is a substantial uniformity of price of cement, it is pointed out that variations of price by one manufacturer are usually promptly followed by like variation throughout the trade. Prices to dealers are not reported to or through the Association. Any change in quotation of price to dealers, promptly becomes known in the trade through reports of salesmen, agents and dealers of various manufacturers. "It appears to be undisputed" the Justice stated, "that there were frequent changes in price, and uniformity has resulted not from maintaining the price at fixed levels, but in the prompt meeting of changes in price by competing sellers."

In concluding the opinion, the Court stated that the Government failed to show any effect on price and production except such as would naturally flow from the dissemination of that information in the trade and its natural influence on individual action.

Fire Resistance of Concrete Columns

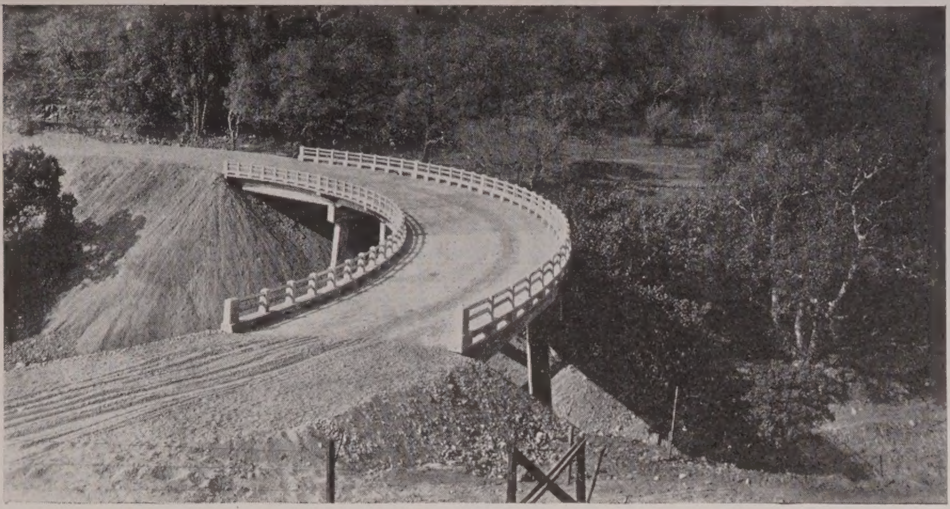
An investigation covering one phase of the work of the Bureau of Standards in the investigation of fire resistive properties of building materials and the fire resistance of various types of structural units is reported in Technologic paper No. 272 of the Bureau of Standards by W. A. Hull and S. H. Ingberg. The study of fire resistance is in turn a part of a general program of investigations to provide information of use in the elimination of economic waste. The study of the fire resistance of concrete columns was made at the former Pittsburgh laboratory to supplement the investigation described in Bureau of Standards Technologic paper No. 184, which was conducted jointly at Underwriters' Laboratories, Chicago, Ill., by the Associated Factory Mutual Fire Insurance Companies, and the National Board of Fire Underwriters, and the Bureau of Standards. The Chicago column tests included only a few concrete columns and it was considered necessary to carry out a more comprehensive investigation which would establish, if possible, the fire resistance of the important types of columns built of concrete made from the principal types of aggregates.

A series of tests was accordingly outlined and conducted at the former Pittsburgh testing station of the Bureau of Standards during the period 1917 and 1919.

Fire tests were made of 62 columns under working load, and 16 comparable columns were tested to failure in compression without fire test. The thickness of concrete or other material considered as protection was 1½ or 2½ in. Concrete aggregates of a wide range in mineral composition were introduced.

The columns were subjected under normal working load to fire exposure increasing in intensity according to a predetermined time-temperature relation until failure or until the end of four hours, when additional load was applied up to the limit of the furnace equipment (600,000 lbs).

A wide difference in fire effects on different columns was noted and was determined as due in large part to difference in mineral composition of the concrete aggregates used. Quartz, chert, or granite induce spalling and cracking of the concrete when subjected to fire, while that made with calcareous aggregates, such as limestone or calcareous gravel, shows little visible effects even from very severe fires. As made with trap rock or blast-furnace slag, the fire effects are intermediate between those above indicated. Shape of section or type of column reinforcement were shown to be of minor importance. It was further shown that with concrete protection of siliceous aggregates or of plaster subject to cracking and spalling, a large improvement can be effected by placing metal ties, such as wire mesh, in the protection. Columns made with siliceous aggregates and thus protected withstood, under working load, fires of 4 hours duration and at their conclusion in the heated condition, loads from two to over four times the working load.



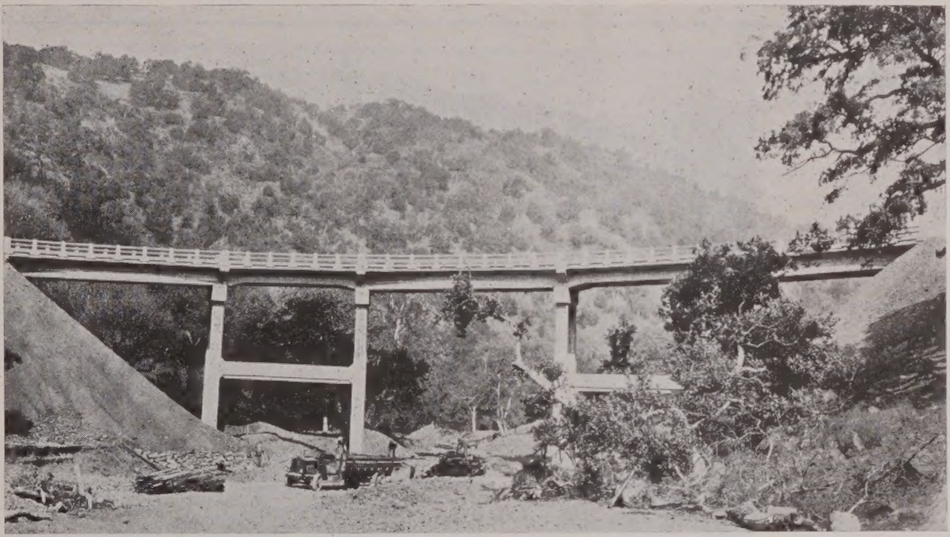


Fig. 1—View of curved bridge over north fork of Pacheco Creek, California, showing superelevation in the roadway

Fig. 2—View of Pacheco Creek bridge showing alternate girder and tower spans

Pacheco Pass Bridge a Complicated Girder Structure

By Harlan D. Miller

Bridge Engineer, California Highway Commission

The California Highway Commission has just completed the construction of a rather unique bridge in that the bridge was built on a grade on a very sharp radius curve over a deep ravine. The bridge is of the reinforced concrete trestle type composed of alternate girder spans and towers. It is located on a pass through the mountains, known as the Pacheco Pass, some 21 miles east of the City of Gilroy.

The new State highway approaches this bridge at both ends down long steep winding grades. The bridge is on a sharp curve at the foot of these grades. It is 218 ft. long, has a 24-ft. roadway width between curbs, is built on a radius of 175 ft. and has 3% grade over it. On account of the sharp curve over the bridge the outside of the roadway was superelevated 24 in.

The structure is composed of alternate 50-ft. girder spans and 34-ft. tower spans. The 24-ft. width of roadway is carried on four girders, these girders being supported on heavy cross girders at the top of the two column bents of the towers. The cross girders of the towers were made exceptionally wide and heavy in order to support the expansion details at the ends of the 50-ft. spans. Expansion joints were placed under the ends of the 50-ft. spans only. These expansion joints were made up of cast steel rockers, the rockers being embedded in recesses in the supporting girders.

At the highest point the floor of the bridge was some 46 ft. above the creek bed and the longest columns were about 34 ft. in height from their base to their cap. The columns were battered 1 in 12 crossways of the bridge and were made 2 ft. 6 in. square.

The view of the underside of the bridge clearly shows its type of construction. The four girders supporting the floor slab can be seen with the diaphragms between them at their quarter points, the cantilever floor slab, the brackets at the ends of the girders, the batter of the columns, etc., are all clearly shown in Fig. 3.

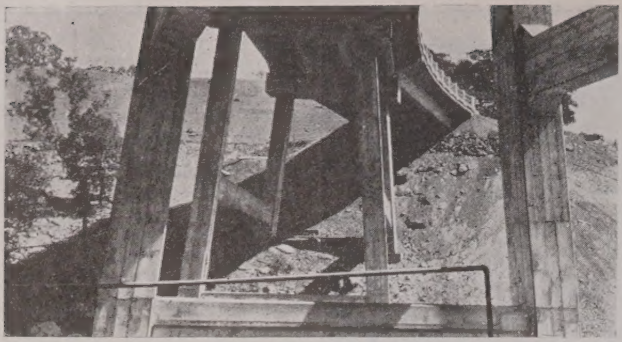


Fig. 3—Under side of bridge deck

The wide easy approaches to the bridge emphasize its gracefulness and the exceptionally large super-elevation of 2 ft. 0 in. in the roadway width is a most attractive feature to the motorist since it permits him to come down the approach grades at a good speed and cross the bridge in perfect ease.

The bridge was designed for a live load of two 15-ton trucks with a uniform load varying from 70 to 130 lbs. per sq. ft. The unit stresses allowed were 650 lbs in the concrete and 16,000 lbs. in the steel.

The bridge was built by John Simpson Co., of Los Angeles, and cost about $28,000. There were 675 cu. yds. of 1:2:4 concrete in the structure. The contract price for the concrete was $26.60 per cu. yd. without the steel which was paid for at 7c per pound in place.

The bridge was built under the supervision of G. W. Thompson, resident engineer for the California Highway Commission.

How British Railroads Utilize Concrete

By A. C. Blackall
London, England

Concrete yard of London & Northeastern Railway at Derby, England

Concrete and reinforced concrete structures and products are playing an increasingly important part in reducing maintenance costs on some of the largest railway companies operating in Great Britain, which are adopting concrete in place of steel, iron, and lumber wherever possible.

The concrete yards of the London & Northeastern Railway Co., at Derby, England, affords a characteristic example. The line is one of the four largest in the British Isles and its concrete yard at Derby supplies its Great Northern and Great Central sections. In 1924 more than 22,000 concrete articles, of varying sizes and types, not including heavy slabs and girders especially made for bridgework, were turned out from this yard. The yard is raised above natural ground level, and has dock walls built on three sides of it to facilitate handling materials, raw materials coming in one side and the finished articles being despatched from the other.

From actual tests extending over a long term of years, this railway company uses well-aerated slag chippings and slag dust for making concrete, although it is sometimes considered impossible to make satisfactory reinforced concrete articles with these materials. The aggregate, with sufficient dust to fill the voids, is fed into a power-driven mixer, and the mixture is emptied from the machine into skips, which transport it over a tramway to that part of the yard where the wood, iron, or steel molds are to be filled. The majority of articles are reinforced with steel mesh or steel bars, the latter being built up in the company's shops into standard types of reinforcement, by means of oxy-acetylene welding.

Some 40 varieties of concrete articles are produced at this yard, among them being fence posts for different types of fencing, gate posts (some of which for level crossing gates are 27 ft. long and 14 in. sq. at the base), guy posts for signal posts or telegraph poles, posts for notices of all kinds, mile and gradient posts, and paving slabs for various purposes. Reinforced concrete depot platforms are made complete in sections, ready for erection, thus economizing in both time and money on the ground. Concrete alignment pegs for permanently indicating the proper alignment of curves, thus insuring smoooth running, are made and used extensively. Posts and slabs are made for erection as boundary walls 6 ft. and 7 ft. high at a much lower cost than corresponding brick walls, and concrete ash-pit sleepers are made and used instead of lumber, thus avoiding damage through fire. Manholes for formation drains are made up in six separate pieces to form the bottom, top and four sides respectively, so that they can be rapidly put together by the drainage squad with a minimum of trouble. This method avoids the trouble and delay of sending to the site bricklayers with bricks, cement and all their paraphernalia.

The whole of this work is, of course, carried out on highly scientific lines, samples from the cement used being tested periodically in the company's own testing laboratory, and other experiments being continually carried out to determine such important factors as the cheapest and best types of molds, the most economical designs for articles in general, and the most effective means of obtaining wear-resisting surfaces.

The Economy of Home-Owning

By W. W. Zass

> Here is a statement of the factor of *permanence* in the comparative economy of house-renting and home-owning. The permanent type of construction lengthens the safe loan period and makes home-owning easier and in the long run—cheaper.
>
> Editor

The three prime motives of man's struggle for existence since the earliest ages have been food, clothing and shelter. As civilization has progressed luxuries have become necessities until at the present period it is a difficult problem for that great mass of people with incomes classed as moderate to satisfy their desires. Especially is this true in regard to shelter. From the cave to the cabin to the modern home is a giant step. The advent of the telephone, gas, electrictiy and kindred other conveniences has manifestly increased the difficulties of the problem involved, that of financing home-ownership.

What has the family with a moderate income the right to expect! What is a moderate income! Does it all depend on the individual and what he or she is accustomed to! And what is the criterion by which we should be guided! When you begin to discuss the minimum wage, the American standard of living, and such kindred topics you advance problems to which there are no solutions. Even as there is no average family either in numbers or in habits, so there can be no figures advanced as to average incomes, average expenditures or average earnings. The individual family must meet its individual problems each in its own individual way.

Considerable propaganda has been disseminated during the past few years that every family should own its own home. As to the merits of home-owning we will not enter into a discussion, it lies without the scope of this article. Our concern is to outline clearly to the home-owner, the prospective home-owner or the habitual renter as the case may be, the actual difference in tangible assets existing at the end of a stated period of time between assets realized from payments made towards home investment or payments made towards rental.

We will not attempt to dictate what percentage of a family's income should be devoted to shelter charges. Rather we will attempt to show the amount of these charges and allow the family to decide whether they are able to assume them. It is true that home values are not constant throughout the country this being due to variations in land values and costs of construction. But it is also true, and an economic law as well, that the ratio between rentals and home values vary as to the home value, rents being high where home values are high and low where home values are low.

For the purpose of analysis we are taking a piece of property valued at $5250. This represents an actual piece of property listed for sale at the price above quoted. It consists of a new, well constructed 5-room frame house, with tiled bath, hardwood floors, and all modern conveniences, but with no basement or heating plant, on a 50-ft. frontage in a desirable neighborhood. The required first payment is $500. the balance to be retired by means of montlhy payments at the rate of $35 per month, the principal bearing interest at 7% per annum. On this basis the total retirement will be accomplished in eleven to twelve years. The total taxes, state, county and city, including paving and sewers amount to $90 annually.

Maintenance and depreciation charges were assumed at $60 per year.

Similar houses in this same neighborhood are renting at $45 per month. Whether or not this rate of rental represents a minimum or a maximum return on the investment will not enter into our discussion, we must confine ourselves in this comparison to values as they actually exist.

For the purpose of this comparison the home owner must take such factors into consideration as:

(1) First payment on home.
(2) Total annual retirements on home.
(3) Interest on loans.
(4) Taxes, maintenance, insurance, etc., on home.
(5) Hypothetical interest on first payment.
(6) Hypothetical interest on annual retirements.
(7) Hypothetical interest on annual interest on loans.
(8) Hypothetical interest on annual payments for taxes. maintenance and insurance.

and the non-home owner must take into consideration such factors as:

(1) Total annual rental payments, and
(2) Hypothetical interest on annual rental payments.

All of the various factors mentioned above are obvious except those styled "hypothetical interest factors." Assuming that a family could live rent free and could place the amount annually paid out as rental in a savings bank, at the end of a certain period of years they would have a sum equal in amount to the annual deposit, multiplied by the number of deposits made, plus the accrued interest on the annual deposits for the period in question. Therefore in computing the total cost of rental over a certain period of years we must take into consideration not only the actual amounts annually paid for rent, but must in addition take into consideration what the accumulated value of these payments would be if placed at interest. The difference between the sum of the annual rental payments, and the sum of the annual payments plus the theoretical accrued interest on same, is what we are terming the hypothetical interest on the payment in question.

Following the same line of reasoning the assumed interest must be considered by the home owner on those different amounts which go towards the first payment on the home, the retirement of loans, meeting of interest on loans, and the payments made for taxes, insurance, and maintenance charges.

In this comparison the rate of this assumed or hypothetical interest is taken at 4% per annum, as this is the prevalent rate of interest paid on savings accounts by banks in this territory, and is therefore considered a fair rate to be used in conjunction with that rate of interest charged on loans by banks in this same territory.

Cost of Home-Owning

Receipts	*Expenditures*	
12 years shelter plus home valued at $5,250.00	First payment	$ 5,00.00
	Retirement of loans	4,750.00
	Interest on loans	2,049.60
	Taxes, ins., maint.	1,800.00
	Hypothetical interest on first payment	300.50
	Hypothetical interest on retirements	1,270.92
	Hypothetical interest on interest on loans	722.39
	Hypothetical interest on taxes, ins., maint.	80.85
12 years shelter plus home valued at $5,250.00	Total cost of home owning	$11,474.26

Cost of Renting

12 years shelter	144 months rent at $45.00 per month	$ 6,480.00
	Hypothetical interest on rent payments	1,634.04
12 years shelter	Total cost of renting	$ 8,114.04

Subtracting cost of renting from cost of home-owning

Home values at $5,250.00	Additional cash outlay necessary to secure home	$ 2,619.60
	Hypothetical interest on additional cash outlay	740.62
	Loss in assets due to renting	1,889.78
Home valued at $5,250.00		$5,250.00

A study of the foregoing tabulation will show that by means of an additional cash outlay of $2619.60 during this payment period a tangible asset of $5250 was assured the home-owner, while during this same period, granting the non-home owner had saved the equivalent of this $2619.60 additional outlay made by the home owner, the non-home owner would have only a tangible cash asset of $2619.60 plus the hypothetical interest on same of $740.62, or a total asset of $3360.22. Therefore there would be a difference of tangible assets to the amount of $1889.78 in favor of the home owner at the end of the payment period, at which time the home is freed of all encumbrances, which period in this case lies between eleven and twelve years. It is true that no provision has been made in these figures for a probable deflation in values, other than for depreciation costs, but it is also true that neither has an allowance been made for any probable appreciation in values. After the home is freed of all encumbrances the balance in favor of the home owner will increase year by year. Thus is the question answered in the affirmative—"Is it more economical to own than to rent?"

While it has been shown that home owning is more economical than renting, a vital point should be borne in mind, in that the home owner is obligated to a greater financial outlay during a given period than is the renter, this under the plan by which home financing is most generally carried out or arranged. While the ultimate savings are greater to the home owner, the initial outlays are also greater. In the typical problem we have advanced, the monthly outlay of the home owner during the retirement period would be equivalent to $75.21 during the first year, becoming smaller year by year until during the eleventh year the equivalent monthly payment would amount to $50.71, these payments as comparable to the rental charge of $45.00 per month for the non-home-owner.

This difference of $30.21 per month, during the first year, may seem of small moment to the more affluent, but to many it might prove to be a barrier erected against any hope of ever owning a home of their own. It should also be pointed out that the home owner had an initial capital of $500 to invest, while of our renter no investment was required.

In the writer's opinion the solution of the problem lies not in the building of flimsy houses of cheap construction and short life, but in building homes of what may be called permanent construction, with low maintenance costs, homes that may last half a century or more. And financing this latter type of construction by means of long term loans, loans similar in character and nature to serial bonds, by which interest payments and retirements of principal can be refunded over a period of from fifteen to twenty-five years, thus enabling a family to live in a house to which they hold title on a payment basis that is actually no more than rental, and with an initial payment of about 10% of the first cost.

That this proposed method would afford relief to a vast number of prospective home owners is evident after a comparison is made with the method previously outlined. For the purposes of analysis we will use the same piece of property as was used in the former outline, i.e., property valued at $5250, initial payment $500, interest on loans at 7% per annum, and taxes, insurance and maintenance charges at $150 per annum but in this case the retirement will be made in fifteen years, and the principal plus the interest on same, will be paid in 15 equal annual installments. The advantage of this latter system lies in the fact that the smaller annual retirements of principal are made during the higher interest periods. As the annual interest payments decrease the annual payments on principal increase. On this basis, for this example, the equivalent monthly payment would amount to $55.96 per month or $671.55 per year, and would not vary during the entire fifteen year period, at which time the home would be clear of all encumbrance.

Cost of Home-Owning

Receipts	*Expenditures*	
15 years shelter plus home valued at $5,250.00	First payment	$ 500.00
	Retirement of loans	4,750.00
	Interest on loans	3,071.97
	Taxes, ins., maint.	2,250.00
	Hypothetical interest on first payment	400.50
	Hypothetical interest on retirements	1,282.19
	Hypotehtical interest on interest on loans	1,337.27
	Hypothetical interest on taxes, ins., maint.	109.80
15 years shelter plus home valued at $5,250	Total cost of home owning	$13,701.73

Cost of Renting

15 years shelter	180 months rental at $45.00 per month	$ 8,100.00
	Hypothetical interest on rental payments	2,712.96
15 years shelter	Total cost of renting	$10,812.96

Subtracting Cost of Renting from Cost of Home-Owning

Home valued at $5,250.00	Additional cash outlay necessary to secure home	$ 2,471.97
	Hypothetical interest on additional cash outlay	416.80
	Loss in assets due to renting	2,361.23
Home valued at $5,250.00		$5,250.00

By this method of payment, by means of an increased payment of $10.96 per month over the payment required for rental, in fifteen years time the renter may become the home owner. If the term of payments were extended over a twenty year period the difference per month in payments made towards home owning and payments made toward rent would be even less.

Contrast this latter method of financing with the one as first outlined. Contrast the $55.86 demanded per month by the second method as to the $75.21 per month demanded by the first method during the first year, and the $50.71 per month during the eleventh year.

It must be remembered however that by the first method the loan is retired in eleven to twelve years while by the second method it takes fifteen years to retire the loan. Of course for those who can afford the greater payment, the first method as outlined has no objectionable features. For those with the lesser annual incomes, the longer retirement period is a necessity.

As stated previously the balance in favor of the home owner grows larger year by year. This saving does not cease once the home becomes free of encumbrance. A comparison of the net savings due to home owning versus renting at the end of the sixteenth year, by either of the two methods of retirement as outlined, show practically identical results, the slight difference being due to the dropping of decimals throughout the calculations. Whatever the plan of retirement the annual savings will be equal in amount, after the retirement period, as the following tabulation illustrates.

ANNUAL SAVINGS HOME OWNING VS. RENTING

After the Home Becomes Free of Encumbrance

12 Year Retirement Plan

Cost of Renting		*Cost of Home Owning*	
Total cost of renting at end of the twelfth year is $8,114.04		Total cost of home owning at end of the twelfth year is $11,474.26.	
Annual interest at 4%...	$324.56	Annual interest at 4%...	$458.97
Loss in assets due to renting at end of the twelfth year is $1,889.78.		Taxes, insurance, etc., annual charge........	$150.00
Annual interest at 4%...	$ 75.59	Hypothetical payment on home during 13th year	608.97
Rental at $45.00 per month annual rental.........	540.00		
Hypothetical rental during the 13th year.........	940.15		

Net loss due to renting during the 13th year equals........$331.18

Net loss due to renting during the 14th year equals $331.18 plus (331.18 at 4%) equals..........................$344.43

Net loss due to renting during the 15th year equals $344.43 plus (344.43 at 4%) equals..........................$358.21

Net loss due to renting during the 16th year equals $358.21 plus ($358.21 at 4%) equals.......................... $372.54

15-year Retirement Plan

Cost of Renting		*Cost of Home Owning*	
Total cost of renting at end of the twelfth year is $10,812.96.		Total cost of home owning at end of fifteenth year is $13,701.73.	
Annual interest at 4%...	$432.52	Annual interest at 4%...	$548.07
Loss in assets due to renting at end of the fifteenth year $2,361.23.		Taxes, ins., maint., etc., annual charge........	$150.00
Annual interest at 4% ..	$ 94.45	Hypothetical payment on home during 16th year	$698.07
Rental at $45.00 per month annual rental.........	$540.00		
Hypothetical rental during the 16th year........	$1,066.97		

Net loss due to renting during the 16th year equals.........$368.90

From a financial standpoint, those who are interested in home owning can be assured that they are making no mistake in such an investment—"HOME OWNING IS MORE ECONOMICAL THAN RENTING."

Concrete Balcony Finished in Quick Time

The entire balcony of Graeper's Egyptian theater, recently built in a suburban district of Portland, Oregon, was completed in a single day by efficient methods in concrete pouring. The entire building, including five modern stores, was completed in 90 days by the Carlson Construction Co. Throughout the job the constructors adhered strictly to the schedule laid down.

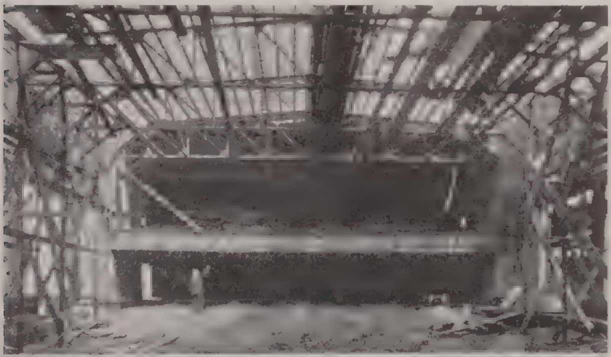


Fig. 1—Interior view of theater under construction, showing forms for balcony, also self centering on roof ready for pouring concrete slab

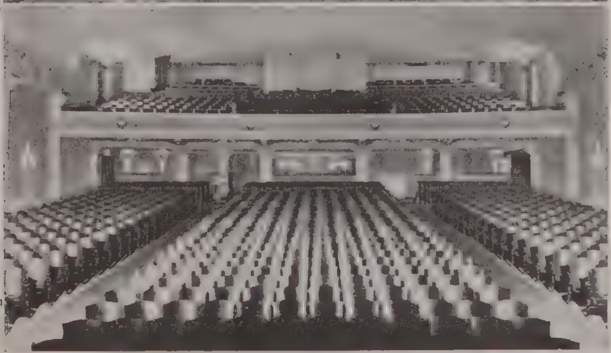


Fig. 2—Interior of completed building. Balcony seating 334 people poured in one day

In the building of the balcony, the workers, of whom a total of 20 were engaged on the building, started work at 6 o'colock in the morning, and everything was complete by 9 o'clock the same evening. The men engaged in the structural steel work kept just a little ahead of the concrete gang throughout the job, with the result that even the roof was completed in a little more than one day's work. In a day and a half, 8800 sq. ft. of concrete was spread on the roof, including the placing of the slab steel, whereas under ordinary methods this work would have taken several weeks.

The method used to so expedite the construction in this case was the following: Steel joists and self centering with a 2½-in. slab were used, the concrete being poured directly on the self centering. This enabled the builders to lessen the dead load on the trusses. In this way the trusses, columns and footings were lightened. The suspended ceiling was carried direct from the roof slab with heavy wire, looped through the self centering supporting the light steel channels of the dome ceiling. The work was then ready for the lath crew to begin operations two days later.

The balcony is approached by an incline from the foyer. This section of the building is well back from the screen and is supported by four large reinforced concrete cantilever beams. There is an overhang of 18 ft. which eliminates the need of supporting columns beneath obstructing the view of persons sitting behind them. The balcony seats 334 people.

The entire building was finished at a cost of $82,000.

Successful Advertising Methods with Ornamental Concrete

By Willis H. Parker

Statue and pedestal built of concrete by Leach Studios in the garden of a fashionable Denver home

How to make advertising of ornamental concrete pay? C. W. Leach of the Leach Studios, Denver, Colo., has tried various methods in the last eleven years in which he has been in the business in Denver. He tried newspaper display space, theater programs, direct-by-mail advertising. He has come to the conclusion that the best advertisement this business can have, is an effective display of merchandise at his own establishment and in the grounds of satisfied customers.

Newspaper space, he says, gives the general public the name and address of the firm, but has so much circulation among classes of people who cannot afford or are not interested in ornamental concrete flower boxes, sun dials, bird baths and benches that rates charged for the space are out of proportion to the effective circulation. This is true to less extent of theater programs, too, reaching a large number of persons who are not prospects for landscape ornaments.

Owing to the peculiar character of the product and its merchandising problems, it is difficult to make a direct-by-mail campaign pay. In the first place it is difficult to obtain a mailing list containing a majority of potential prospects—the average mailing list would be worthless. Furthermore, because of the durability of the goods, repeat orders are infrequent. That is, when a man buys a bird bath built of concrete, that bird bath will last for years, unless, of course, it is accidentally broken which does not happen often. Hence this purchaser is not a prospect for a new bird bath in a year or two. As Mr. Leach says, some of the material built of cast stone will last long after the present generation has passed away. Once you have supplied a home owner with all of the benches, fountains, bird baths, etc., that his place will stand, you have exhausted a further market there. Hence later letters to him urging more purchases are valueless. Few people can afford them and many of those who can afford them do not appreciate their value.

The best advertisement a dealer in ornamental cast stone can have is display, so Leach has tried to solve his problem with display.

At present the studios are on Logan street, one of the busiest recreational streets in the city. There probably is no street in the city of Denver which carries a greater number of motorists who drive leisurely along seeking recreation and pleasure. It is one of the main highways leading into the city from the south and every Sunday hundreds of motorists use this street to get out of town for a picnic or return to the city afterwards. Broadway, four blocks away and running parallel to Logan, has more traffic but it is traffic which is rushing pell mell to get somewhere and hasn't time to "see the sights" along the way. Leach formerly was on Broadway and that was one of the reasons he moved to his present location, which is in a residence district and the studios are located in a home environment, The housing is that of a former residence which has been somewhat remodeled on the interior with the shops at the rear. The lawn in front of the place is kept neatly trimmed and green and specimens of the products are artistically arranged to greet the eye and attract the attention of passersby. I said "artistically arranged" but I probably should modify that statement to "as artistically arranged as is possible with scores of specimens on display," for the lawn contains more exhibits than would be proper for beauty in landscape architecture. But there was a purpose behind this. The more pieces on display, the more likely the public would deem the place something more than an ordinary home and pause to investigate or to wonder about it.

More prospective customers are gained by the display of

A fountain and statue made by the Leach Studios in the garden of the home of Mr. and Mrs. Oscar Malo, Denver, Colo. Mrs. Malo is standing on the steps of the summer house

Ornamental concrete garden seats built and installed by the Leach Studios in the garden of Mrs. A. A. Miller, Denver, Colo.

the goods on the lawn than are gained by any other medium except, perhaps, those gained from satisfied customers. More than 75% of the business comes from the recommendation of persons for whom the Leach Studios have done work. The small amount of newspaper advertising Leach uses is merely for the purpose of letting these prospective customers know where the studio is and that the firm is still doing business. As a means of creating new business, the newspaper advertising does very little good, according to Leach. What value there is in newspaper space is greater in the morning paper than in the afternoon papers, for the morning papers as a rule are more conservative and are more thoroughly read than are the afternoon papers, and furthermore the morning paper usually goes to a class of people who would be more likely to want his products than the usual run of newspaper readers.

Some direct-by-mail advertising has been used with fair return in the last few years. Leach will attempt additional campaigns in the future, but the mailing list will be small and exceptionally selective. And it will be a question whether it will really pay at that. The slogan to be used in future advertising, both by mail and in newspapers will be "A Thousand to One." The idea being that a thousand people see the outside of your home to one who sees the interior and therefore the great majority of the people judge your personality by the exterior decorations of your residence.

As to the value of location in displaying products, Mr. Leach declares that he has been on Logan street four years. He was on Broadway seven years, but his fourth year on Logan street showed business three times greater than the best year he ever had on Broadway, although there was more traffic on Broadway than on Logan and of a different class. Sundays, naturally, are the big days for displaying goods, for it is then that motorists of Denver drive around town for pleasure and sight seeing. Broadway, being a business street, would not be patronized by recreationists as much as Logan would be.

The conclusions to be drawn from Leach's experience are that if you are in this sort of business, don't hunt for a location in a cheap district. Go where people will pass your place—motorists especially. The rent may be higher, and you may have to spend more time in keeping the place artistically clean, but you'll get more business.

Other business methods followed by Mr. Leach may be of interest and value to the trade. He says there are no secrets in the business so it all can be "spilled." He says that one of the greatest troubles in cast stone work is the failure to use enough cement. He uses a mixture of two to one. Another difficulty is not getting the molds right, and a third costly practice is trying to repair a broken cast. Some of this may not be new without proper explanation.

As to the proper mix, he does not consider cement an expense. The amount saved by skimping on cement does not offset the amount lost by the failure of the casts to stand the handling, not only in the shop but after it is set up on the customer's lawn. Your satisfied customer is your best advertisement, hence the additional cement he uses to turn out what he considers a quality product may be charged to the advertising appropriation, and not to production cost.

Failure to get the molds right is another source of production expense. He is solving this problem by having the molds of popular designs made in iron. This eliminates danger of breakage and they always go together properly, eliminating much time in fitting. The iron molds may cost more at first but the amount they save in the course of a year is wonderful.

Now as to repairing broken casts. There is nothing like this done in Leach's shops. Time, and therefore money, is saved by throwing out a broken cast and making a new one. Leach says he is able to repair a break so that it cannot be seen and is stronger than the cast was originally, but the time required for this repair work is too costly. He believes this is where many cast stone workers lose money.

Water curing of all work is the method followed. He does not think well of the newer steam curing process, believing that the steam has a tendency to dry out the cement instead of letting it crystallize properly.

A business policy followed by Leach is never quibbling over replacing an article which broke after it was set up on the customer's lawn. It may have been the customer's fault, but if there is the slightest indication that it might have been the fault of Leach or his men, it is replaced, although it may mean a loss of several dollars. There aren't many instances of this sort, for the product Leach turns out is exceptionally strong.

Besides a sound business policy, there is another factor which has contributed to Leach's success—he is an artist; a painter of pictures. He drifted into the cast stone business from necessity eleven years ago. He found he would have to do something other than merely paint pictures if he were to make a living. He had no previous training in this sort of work and had no one to teach him anything when he started. It was a hard struggle and a costly one, but he stuck it out although there were times when he wished he could shut up the doors of the shop and never go back to it again. But it is the artist in him that puts the "feel" to his work.

"Garden furniture" is chosen as the generic name for garden seats, fountains, flower boxes, bird baths, and so on.

Finally, for the interesting catalog used, the unusual and inviting title, side by side with, "Garden furniture of enduring cast stone," is "One thousand to one, or why beautify the exterior?"

The explanation of the unusual title is found in the first paragraph of text: "Is it not true that thousands of your good fellow citizens constantly see the exterior of your home to every one who is privileged to come inside?"

The booklet which is 6¾ in. x 6½ in., folding to go readily into a small envelope, contains many illustrations which are "representative" of the hundred and more models and designs, molds for which are in stock, and many of which can be completed within two weeks time.

What is offered in this catalog, specifically, with quoted prices, will interest the trade at large. There are cast stone flower pots in three designs and sizes at $7.50 to $16.50. Cast stone pots are offered at prices from $3.00 to $18.00 Urns and jardinieres are priced at $10 and $30. A bungalow type pot is quoted at $7.50 to $15.00. Other cast stone urns are quoted at $10, $18, $20, and $12.50.

There are sun dials at $40.00 and $50.00.

Bird baths are quoted more numerously than any other item. There are fifteen different styles, and prices range from $17.50 to $50.00; height and diameter have a great deal to do with the price.

Garden benches and seats are quoted at $35, $45, $60, and $75, while cast stone flower boxes are quoted at $7.50, $12.50, $15.00, and $25.00.

Precast Units in Railway Grade Elimination Work

Improvements in grade elimination work along the Pennsylvania R. R. system at Cleveland, Ohio, involved the elevating of the track. It was found necessary to build a track 10 ft. higher than the right of way at the Pennsylvania warehouse in order that the first floor of the warehouse which had already been completed would be on the same level as the floors of cars which were to be loaded and unloaded on the adjacent track. Flexible, interlocking concrete cribbing of I-beam construction was used.

The accompanying illustrations show the units patented by The R. C. Products Co., Cleveland, Ohio, and the noteworthy features of this new use for concrete cribbing include the fact that the structure was found to absorb the vibration caused by running two of the largest Baldwin locomotives over it. This type of wall presents a very favorable facial appearance and takes care of frost action and drainage problems. The system consists essentially of only two types of members: face members, or stretchers and anchor members or headers, the design being such that the header and stretcher automatically interlock and square away. No dowels are used and there is no mortaring of joints. To these properties is attributed the ability to carry the tremendous test weight applied to the finished structure.

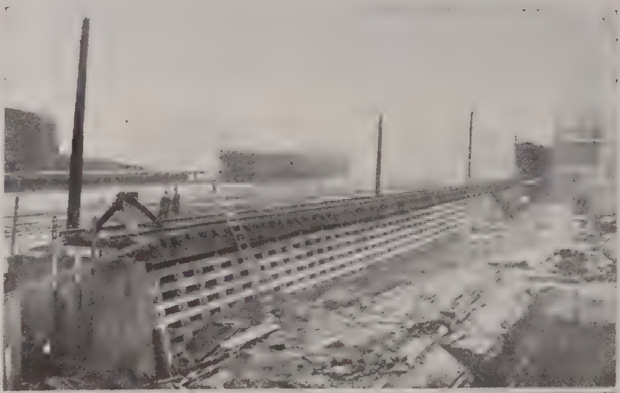
The system lends itself readily to surrounding conditions. At one end of the improvement, it was found necessary to clear a switch stand. Expensive special form work would have been required in a monolithic wall, but the same results were obtained with the cribbing by building an indenture of about 1 ft. at practically no additional expense or trouble. No special equipment was used and the units were handled by a small crew of men. The cost of erection was remarkably low.

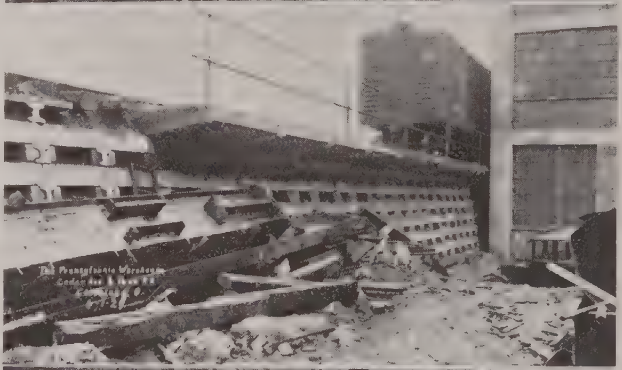
This wall could have been built one section at a time and the excavation for each section used as back-fill for that preceding. It was unnecessary to follow this method with the Pennsylvania track and the wall was built the entire length and then the back-fill hand rammed in 8-in. layers in order to compact it around each member. No massive foundation was required. The wall was started just 23 in. below the ground level to get below the frost line.

In laying the wall, the beam construction was decided upon. Joints were broken in alternate courses so that they would be evenly distributed over the entire wall. Girders for the face of the wall were spaced on 3-ft. centers and the rear of the wall was built along identical lines with stretchers breaking joints alternately.

Fig. 2 illustrates the adaptability of the precast I-beams to floor and roof construction. The loading platform at the Pennsylvania warehouse is supported by precast building beams. Care was taken in building the cantilever platform that the projecting portion of the beams did not exceed one-third of their entire length. These building beams took the place of the headers and were spaced on 6-ft. centers. A 12-in. slab of concrete was then poured across the entire length of the crib wall.

In ordinary floor construction, the beams are spaced from 8 to 30 in. on centers, carrying live load of from 40 to 400 lbs. per sq. ft. Concrete slabs 1 in. thick are used to close the opening between beams. From 2 in. to 6 in. of concrete is poured over the top of beams and slabs.





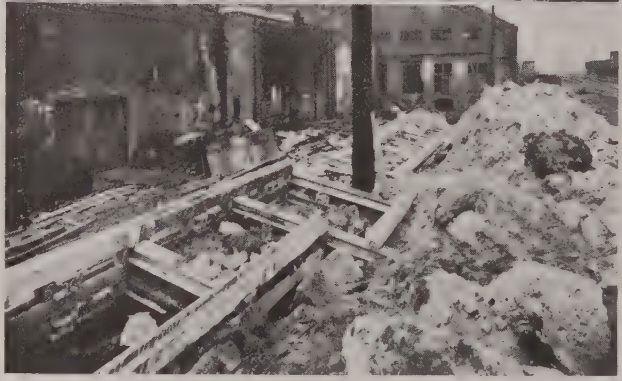


Fig. 1—Track elevation at Pennsylvania Warehouse, Cleveland, Ohio. R. C. patented precast units

Fig. 2—Close-up view showing adaptability of precast units to cantilever platform construction

Fig. 3—Laying the foundation units

The Unit

The stretchers are 6 ft. and 12 ft. long, 8 in. high and 7¼ in. wide. They are made in the form of I-beams reinforced each with ¼-in. square twisted bars running the full length of each member. Tie wires 12 in. o. c. and 7 in. from the end are used to keep the steel accurately placed. To doubly insure the accuracy of placing of reinforcing, steel washers are placed around each bar at intervals of 2 ft.

The headers are of lengths varying from 3 ft. to 12 ft. equipped at each end with automatic interlockers of rein-

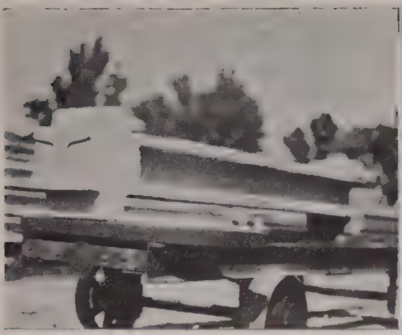


Fig. 4—Standard header, 6 ft. long, 8 in. high and 7¼ in. wide

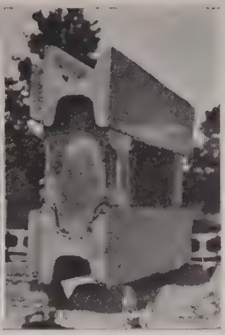


Fig. 5 (right)—Newly patented interlocker, showing short header interlocked by two sections of stretcher

forced concrete that were formerly designated as filler and pillow blocks and are now poured monolithic with the headers. This automatic interlocker does away with dowels sometimes used in cribbing.

It is pointed out by the designer that the wall forms a very thoroughly interlocked construction. The headers may be staggered if desired. All members have been carefully designed to withstand the loads and earth pressure to which they will be subjected in retaining the earth fill. The proper openings are provided to permit perfect drainage, without permitting dirt to pass through the openings left in the face of the wall. This is considered a very important point and the earth should not pass until the slope exceeds 1½ to 1.

Walls may be built of these units to a height of 50 ft. Particular attention was given in the designing of the two units to keep the weights within reasonable limits, so that the cost of handling would not be too great particularly for high walls, and so that any wall of any desired height could be erected by a small gang of common laborers, without special construction equipment. The stretchers weigh 31 lbs. per ft. and the headers 35 lbs. No particular skill is necessary as long as care is taken in obtaining the proper foundation and batter. Some of the walls constructed have a batter of only 1 in. to the foot to conserve every bit of yard in the railroad terminal. The batter usually used is 2 in. per foot and for certain unusual walls of exceeding height, it has been found desirable to use a batter of 3 in. and to go back into the rear of the wall three rows of 6-ft. headers, this being possible only with the patented system of interlocking.

Curvature of the wall does not present any unusual problem with this type of cribbing. By proper and careful adjustment of stretcher lengths any desired radius of curvature can be readily and accurately maintained. Temporary crib walls which are often necessary in railroad terminals may be laid and re-laid as aften as desired without any waste or deterioration. The above information and photographs were made available by William H. Evers, Jr., engineer in charge, of The R. C. Products Co., Cleveland, Ohio.

Causes of Non-Uniformity of Concrete

A symposium from *Public Roads.*

In May, 1924, the Bureau of Public Roads forwarded to each of its district offices and to all state highway departments a tabulation showing the results of compression tests on cores drilled from several concrete pavements in each of four widely separated states. The test results indicated a lack of uniformity in strength of the concrete taken from the several projects, and the bureau requested those to whom the tabulation was sent to reply with suggestions as to ways and means of improving the uniformity of concrete.

Replies were received from 27 state highway departments and practically all of the district offices. The replies have been analyzed and are now presented in tabular form for the information of those who participated in the discussion and for highway engineers in general. It was hoped by this means to bring out corrective measures of immediate practical application. While the opinions expressed are interesting in their variety, it must be conceded that the majority of the remedies suggested are either quite obvious or lacking in the means of application. The divergence of the opinions is, at least, significant of the complexity of the problem of uniform concrete production.

The subject as a whole is one of prime importance, and it is thought that publishing the information collected will suggest new lines of thought for some and perhaps stimulate investigation and research. All of this should ultimately be conducive to better concrete and better pavements.

The first and larger part of the tabulation is devoted to the opinions of those who accept the results of the compression test on drilled cores as a measure of the strength of the concrete in the pavement. The numerous recommendations for rigid inspection and close field control stand out prominently among the remedies suggested. This factor, undoubtedly of vital importance, is mentioned by some states in which inspection and control are notoriously weak, which suggests the question as to why, if the weakness is recognized, the necessary steps are not taken to correct the faulty conditions. By comparison of paving work in various localities it is quite apparent that the additional cost of intelligent inspection and a well-planned control of materials and construction is a profitable investment, which is reflected in the quality of the pavements. Without adequate control no scheme for producing better pavements can be properly administered or enforced.

It is of special interest to note that one state claims to obtain uniform concrete as a result of uniform consistency and accurate measurement of materials. This claim is supported by the results of core tests on a number of pavements.

The second part of the tabulation deals with the validity of the compression test on cores. Certain factors are pointed out which may influence the test results to a considerable extent, and it is well that attention be directed toward them. Definite objection is also expressed to the policy of using the results of core tests as an indication of the strength of the concrete. It still remains to be demonstrated that the beam test is a better or more reliable criterion than the compression test on cores. If it is eventually accepted that the beam test is superior, it will then be necessary to develop some convenient and practical method for obtaining beam specimens from the pavement. It is not contended that pavements fail under static load by direct compression, but on the basis of present information it seems reasonable to use the results of tests on cores in a comparative manner for any one pavement as a measure of the strength of the concrete.

The methods employed in constructing the average concrete pavement are in themselves the most convincing evidence that there must be a considerable non-uniformity of concrete. The variation in grading of the coarse aggregate, the lack of accuracy in measuring aggregates, the variable consistency, the shoveling of mortar from fresh batches to supply deficiencies in preceding batches, and inadequate or non-uniform curing are some of the main factors which can be verified by mere inspection and which are apt to contribute to variation in the strength of the concrete. How to correct or improve on these conditions is the problem.

Abstract of Suggestions of State Highway and District Offices with Regard to Non-uniformity of Concrete as Demonstrated by the Compressive Strength of Cores Drilled from Pavements

Causes of Non-uniformity	Suggested by—		Remedies for Non-uniformity	Suggested by—	
	States	District offices		States	District offices
1. Cement:			1. Cement:		
(*a*) Variation in cement from one plant	2	1	(*a*) Beyond reasonable control	2	....
(*b*) Variation between different brands	3	2	(*b*) Use only one brand on a project	....	1
(*c*) Storage of cement	....	1			
2. Water:			2. Water:		
(*a*) Variation in quality	2	....			
(*b*) Acidity or alkalinity	2	....	(*b*) Test with litmus paper	1	....
3. Aggregates:			3. Aggregates:		
(*a*) Variation in grading	7	6	(*a*) Educate material plant personnel	1	....
			Beyond reasonable control	1	1
			Rigid inspection	....	2
			Control by tests	2	....
(*b*) Variation in cleanliness	2	2	(*b*) Beyond reasonable control	1	2
(*c*) Variation in quality	2	2	(*c*) Beyond reasonable control	1	1
			Control by tests	1	....
(*d*) Segregation of coarse aggregate in stock piles	2	1	(*d*) Stock pile in layers	1	1
			Combine separate sizes at proportioning plant	2	1
(*e*) Bulking of sand due to moisture	5	1	(*e*) Weigh aggregates and correct for moisture	1	1
4. Construction processes:			4. Construction processes:		
(*a*) Variation in consistency of concrete	21	6	(*a*) Slump test	2	....
			Beyond reasonable control	1	1
			Weigh aggregates	....	1
			Accurately measure and proportion water	4	1
			Accurately control water for each batch	3	....
			Add hydrated lime to cement	1	....
			Use moderately wet mix and then squeeze out excess water	1	....
			Closer observation by inspector and foreman	1	....
			Use mixer which will discharge concrete of proper consistency	....	1
			Correct leaky valves on mixer	....	1
(*b*) Inaccuracy in measuring aggregates	12	5	(*b*) Proportion by weight	3	3
			Measure accurately and uniformly by means of independent measureing devices	1	....
			Use accurate measuring devices	1	....
			Use batchers	1	....
(*c*) Segregation of concrete in mixer and in pavement	5	....	(*c*) Improve control of consistency	1	....
			Avoid central mixing plants	1	....
			Decrease maximum size of stone	1	....
			Change design of mixers	2	1
(*d*) Variation in time of mixing	9	2	(*d*) Rigid inspection	....	1
			Require 1½-minute mixing period	1	....
			Require 2-minute mixing period	1	....
			Use batch meter	2	....
			Require uniformly definite time of mixing	1	....
(*e*) Overstanding	1	1	(*e*) Proportion aggregates by weight	....	1
(*f*) Arbitrary proportions	2	1	(*f*) Use scientific proportions	1	....
(*g*) Too much tamping	1	....	(*g*) Tamp slightly with not too dry a mix	1	....
(*h*) Insufficient tamping	5	....	(*h*) Use mechanical tamper	3	....
			Tamp uniformly	1	....
(*i*) Use of boom-and-bucket mixer	1	....			
(*j*) Variable cement factor	1	....	(*j*) Careful inspection	1	....
(*k*) Equipment in poor condition	1	....			
(*l*) Variation in manipulation	4	1	(*l*) Avoid shoveling and handling after dumping	2	....
			Use boom-and-bucket mixer	1	....
(*m*) Variation in pavement thickness	1	1	(*m*) Accurate subgrade and rigid inspection	....	1
5. Curing:			5. Curing:		
(*a*) Variation in later curing due to wet and dry subgrades	1	1	(*a*) Beyond reasonable control	1	1
(*b*) One section shaded, another exposed to sun	1	1	(*b*) Beyond reasonable control	1	1
(*c*) Non-uniform curing	6	3			
(*d*) Variation in nature of material used for cover	1	2			
(*e*) Variable absorption of subgrade	2	2	(*e*) Use tar paper on subgrade	....	1
(*f*) Inadequate curing	5	2	(*f*) Pay more attention to proper curing	1	....
			Keep pavement wet for at least 14 days	1	....
			Have contractor cover this item in his bid	1	....
(*g*) Absorption by dry subgrade	1	....	(*g*) Wet the subgrade	1	....
(*h*) Temperature changes during curing period	....	1			
(*i*) Temperature changes during construction period	3	....	(*i*) Protect work adequately during early fall	1	....
(*j*) Rise or fall of temperature during setting period	1	....			
(*k*) Effect of freezing	2	....	(*k*) Lay no pavement at 40°F. when temperature is falling	1	....
6. Engineering supervision:			6. Engineering supervision:		
(*a*) Poor control and inspection	8	3	(*a*) Require carefully supervised system of inspection and testing	1	....
			Need high-class, intelligent inspection and constant engineering control	1	....
			More rigid specifications and enforcement of same through efficient inspection	1	....
			Rigid inspection	....	1
			Adequate inspection	....	1
			Intelligent inspection	....	1
			More efficient and competent inspection	1	....
			Rigid inspection and control of materials, also accurate and complete inspection record	1	....
7. Miscellaneous:					
(*a*) The main feature yet to be perfected is the accurate measurement of the mixing water				1	....
(*b*) Study of design and specifications required to get uniform working conditions				....	1
(*c*) Extend the laboratory work by relating the test record as nearly as practicable to construction conditions				1	....
(*d*) Study means of controlling variable moisture contents of subgrade due to weather and soil conditions				1	....
(*e*) Investigate means of allowing for bulking of sand due to moisture				1	....
(*f*) Surface finish of pavement considered to be a factor of supreme importance				1	....
(*g*) Adequate and competent engineering supervision, and accurate proportioning of materials are the whole solution				....	1
(*h*) Uniform concrete is being obtained as a result of uniform consistency and accurate measurement of materials on all contracts				1	....

ABSTRACT OF COMMENTS ON THE COMPRESSION TEST OF CORES AND THE USE OF THE TEST RESULTS AS AN INDICATION OF THE QUALITY OF CONCRETE IN PAVEMENTS

Comments on Compression Test	Suggested by—		Remedies for Inaccuracies of Compression Test	Suggested by—	
	States	District Offices		States	District Offices
1. Ends of specimens not true planes perpendicular to vertical axis	3	1	1. Grind ends of caps	1	....
2. Size of specimen not proportional to maximum size of coarse aggregate	1	.....	2. Cast some sections of pavement 12 inches thick for drilling cores	1	......
3. Variation in speed of test	3	1	3. Use greater care to get uniformity	....	1
4. Age of specimens not given proper consideration	2	3			
5. Variable diameter of the core	....	1			
6. Variation in height of cores	2	....			
7. Injury to cores by drill	3	....	7. Use molded cylinders for early ages	1	....
8. Personal equation of test operators	1	....			
9. Strain in specimen due to temperature stresses	1	....	9. Do not drill close to a fracture	1	....

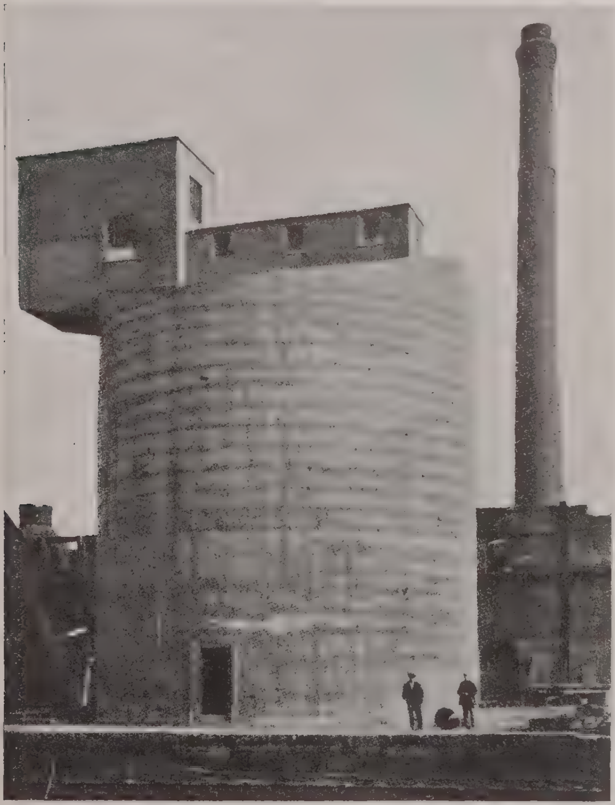
Miscellaneous comment (From three States and two district offices):

1. Does the compression test on cores indicate the quality of concrete in the pavement?
2. The core test is unreliable as a criterion of the strength of concrete.
3. The nature of the specimen and the method of test make the core test unreliable.
4. More reliance should be placed on the tensile-strength test than on the compression test.
5. Use compression test only in conjunction with test on beams.
6. Use average of three cores from one locality for the equivalent of one core result.
7. Investigation required to determine reliability of core test.
8. Use beam tests instead of test on cores.

New Silo for Cement Storage in England

The accompanying illustration shows a silo recently completed for the Associated Portland Cement Manufacturers, Ltd., at the company's Arlesey works at Bedfordshire, England. The silo proper is 55 ft. high to the underside of the roof slab, with an external diameter 42 ft. 6 in. and a total capacity of 3000 tons of cement.

The complete scheme comprises, in addition to the silo, a machinery pit, a feed-screw chamber on the roof and an extractor-screw chamber at floor level. An existing cement warehouse adjoins the machinery pit and the wall of the pit, part of which is 18 ft. deep, and was designed strong enough to take the load of the warehouse as well as the weight of the soil retained. Water was encountered in the marly chalk on which the silo is built during the excavation. Owing to the condition of the material under the footings, they were designed for a load not to exceed 2 tons per sq. ft.



Reinforced Concrete Cement Silo at Arlesey, constructed for the Associated Portland Cement Manufacturers, Ltd.

Courtesy Concrete and Constructional Engineering.

The walls of the silo are 12 in. thick at the bottom, tapering to 7 in. at the top and are reinforced with mild steel bars of various diameters. There are two door openings in the walls at the ground level, each 6 ft. high x 3 ft. wide and at the level of the bottom of the silo is another large opening measuring 7 ft. x 5 ft. In placing the reinforcing bars, tension bars were bent and taken under or over the openings. The sides of the door openings were grooved to receive 9 in. x 2 in. boards, fixed louvre fashion and on the outside face of the walls near the doors, short lengths of rolled steel joists were fixed to take the 9 in. x 3 in. external timber door frames. The bottom of the silo is 8 in. thick, reinforced with a mesh of mild steel bars, the slab being independent of the walls and not bonded to them in any way.

The extractor-screw chamber is hopper shape with walls 17 in. thick of reinforced concrete. There are two lines of extractor screws and poke holes and delivery hopper openings were provided on both the walls of the chambers.

The roof of the silo is partly flat and partly sloping. It is carried on two main beams and two secondary beams, the main beams are cantilevered out over the wall providing a projection of 11 ft. to carry the feed-screw chamber. The elevator house and the feed-screw chamber extend over the whole length of the roof. Three openings in the floor of the feed chamber are provided, through which cement is discharged into the silo.

Access to the silo is obtained through a dust-proof trap door in the roof through which wrought iron ladders are fixed down to the floor below.

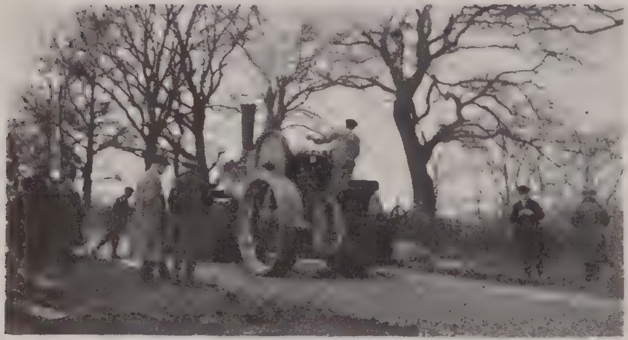
Blaw-form steel shuttering was used in the construction of the walls of the silo portion, two courses totaling a height of 4 ft. being fixed all around the building and concreted to this height in one operation.

The reinforced concrete work was designed by T. A. Harvey, consulting engineer, on behalf of the London Structural Co., Ltd., who had the contract for the work.

A Macadam Type of Road Surface Bound with Aluminous Cement

By H. C. Badder

London, England



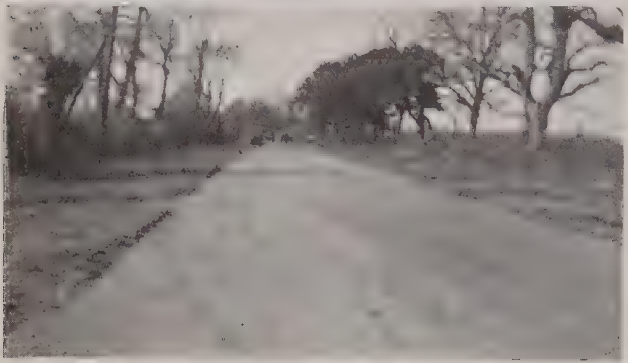


Fig. 1—Rolling in the new aggregate. Note the timber form on the center of road

Fig. 2—The finished surface

In the early days of 1924 some experiments were made in Kent to bind the surface of a macadam road, using one of the brands of aluminous cements mixed with sand as a binder in place of the usual fine material, and water spread and rolled into the interstices of the stone, which was previously rolled in dry to a firm bed before using the binding grout.

This attempt to improve the surface of a macadam road, while not perfect, was sufficiently promising to the engineers in charge of the work that they decided to make another trial with some improvements in method upon part of the macadam road. This trial was so successful as to strength of the finished surface and low cost of the work that the method was, with further developments, taken up by W. B. Purser, County Surveyor for Lincolnshire, who decided to make a thorough test of the process by constructing a section on the main road between Lincoln and Grantham some 200 yds. long and 20 ft. wide, completed in June, 1924.

The old macadam was scarified, regulated in thickness and rolled, then new charnwood granite broken to a 2-in. gauge was spread 3 in. thick and the surface shaped and dry-rolled with a steam roller to a thoroughly consolidated hard and even bed ready for binding together.

The binder, consisting of one part of aluminous cement to seven parts of fine granite chippings and sand thoroughly mixed together dry, was spread to a thickness of ½ in. over the surface of the granite. It was then watered by means of a water cart with spray delivery and the binder brushed in with brushes by exactly the same method as is used upon a water bound macadam road, and rolled again with the steamroller until a satisfactory finish was obtained.

This portion of the road, after a year's use and the testing effects of a wet summer and winter, has a surface as good as the day it was finished and there has not been a single loose stone found during this period, the surface forming a good foot-hold for horse traffic.

Lincolnshire is mostly an agricultural county, therefore the traffic on this road is about 600 tons daily, making a total of about 150,000 tons (of which three parts is motor traffic and one part horse traffic) has passed over the road since completion, the surface remaining in perfect condition without any cracks or pot-holes being formed, and no repairs have been made to this date (May 1925).

Recently a similar road has been constructed near Glasgow and one is now under construction on a portion of the main road between Aylesbury and Buckingham, about 400 yds. long x 21 ft. wide.

The writer was invited to inspect the construction of this road during the first week of April 1925 and found the method of construction was carried out upon similar lines to that used by Mr. Purser, with what may be termed minor improvements, and are described as follows:

(A) Scarify the surface of the road, even up to a proper camber and roll this surface with a steam roller.

(B) Spread the new 2-in. granite to the required thickness and camber and dry roll to a thorough consolidation.

(C) Prepare the binder of aluminous cement in the desired proportions with clean sharp sand in the proportions of one part of the cement to seven parts of sand thoroughly mixed four times dry.

(D) Spread the mixed dry binder about ½ in. thick over the surface of the rolled granite.

(E) Sprinkle the spread binder by means of a water tank cart to a slurry and sweep it by means of brushes in every direction over the surface to fill the voids in the granite.

(F) Roll again with the power roller to thoroughly consolidate to a finished surface.

Owing to the traffic conditions only half the width of the road was treated. The part of the road completed before my visit was firm and hard, at three days old a portion broken into for examination showed the grout or slurry had penetrated the full depth of three inches and the voids between the granite were well filled, so that the stones were jointed together by the binder.

There is still room for improvements in application, and no doubt this will be achieved by practice.

The workmen on the job were not very certain about the operation they had to carry out, which required more skillful handling than they could give. Too much water was used in mixing the slurry and owing to the camber of the road from the center to the grass covered shouders at the side, a lot of the water in the slurry ran off the road surface and undoubtedly carried away a quantity of cement before the men could get the slurry properly mixed and spread. As is common in much concrete work, the details were in the hands of the workmen who needed more training and the work more controlled by mechanical means.

A portable water tank and tower with a pump is a necessity so that the sprinkling may be done by a hose pipe with a fine rose delivery, and the mixed spread binder can be watered to a slurry at a speed suitable to the number of men employed in sweeping. A water tank cart is much too coarse an implement for this purpose.

The final rolling of the surface is necessary to press in stones swept out in spreading the slurry, and this is the crucial point of the whole process, because if too great a quantity of water is used and the slurry made too thin its penetration into the voids between the rough cubes of the granite causes a floatation of the aggregate when the roller is being used to bed the granite again, and this prevents an even top surface being made without hollows to the required camber.

Other experiments have been privately attempted to improve this method of constructing a really cheap road crust that will carry a fair weight of traffic and resist weather conditions. Among other efforts, laying the mixed binder wet over the reshaped base and spreading the new aggregate over the mortar in the hopes it would rise when rolled to fill the voids has been tried. The failure here was that the weight of the heavy power roller caused the mortar to squeeze up on to the surface, and the mixture stuck to the wheels of the machine, making the work impossible.

It has been suggested that the fine and coarse aggregates with the binder should be mixed dry, laid, rolled, and then watered and rolled; this might be satisfactory but it is getting too close to proper concrete methods, and while the writer hopes to supervise a test of constructing a road with semi-dry concrete so that it may be rolled to a dense bed and be cured by a ponding method to eliminate water voids and make the resulting concrete practically impervious, he believes both methods would be much more costly than the one under review.

The addition of a quick setting binder to the ordinary methods of forming a water bound macadam road is the cheapest improvement yet discovered in road making, if only for its usefulness in binding a sub-base to carry an asphalt carpet as a surfacing for main roads and as a finished surface crust for second class roads.

It is cheap. For a 4-in. top cover a cubic yard of mixed aluminous cement binder mixed 1:7 would bind 50 super yards. In the proportions of 1:4 of this cement and sand the cost would be increased 25% over the former mix but the strength would be increased 25% if properly applied, and traffic would have to be diverted a few days in either case.

The following specification is suggested as a step further in standardizing methods.

(1) Large hard clean stone or gravel to be crushed to 2 in. down, and all material screened out below 1 in. to be recrushed for sand or used for other purposes.
(2) Hard clean sand passng $\frac{1}{16}$ in. mesh sieve and 90% retained upon sieve having 50 meshes per sq. in.
(3) Proportions of one part aluminous cement to four parts of sand.
(4) Scarify the old road, level up, and well roll with a power road roller.
(5) Lay and roll the new aggregate to the required thickness and shape to proposed camber.
If the shoulders are not sufficiently firm and strong, dig a suitable shallow trench and fill with large stones to resist side pressure in rolling.
(6) Mix the binder and sand in the required proportions and add sufficient water in a large barrel type engine-driven mixer to form a slurry with a slump of about 8 in.
(7) Spread the slurry over the rolled aggregate by chuting or other apparatus and lightly brush and cross brush over the surface to fill voids.
(8) Roll the slurried surface twice, adding more slurry if required, spread and brush behind the roller so that on second rolling a thin layer of binder is visible above the surface.
(9) Lay and roll new aggregate the full width of the road and at least a day's work of grouting and binding the surface in length so that as much binder may be spread and rolled as is possible in the two hours before the initial set has commenced. The use of two power rollers will reduce the cost of the work and promote a better job with fewer joints.

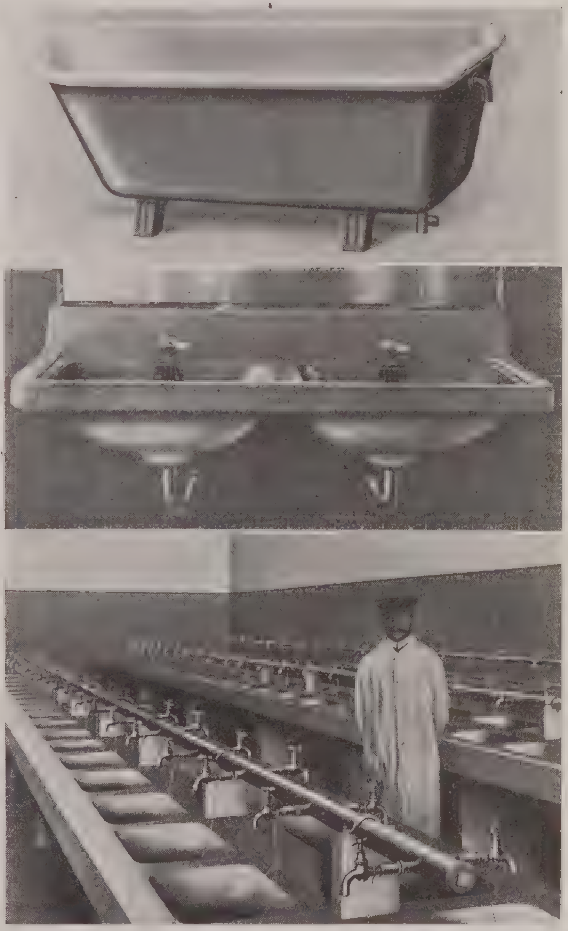
The work being properly carried out with a minimum quantity of water, a good lasting road unaffected by water or frost and a hard level surface for traffic is secured at the lowest possible cost.

Concrete Sanitary Ware

By F. A. Brackmann

BERLIN-LANKWITZ, GERMANY

The manufacture of concrete sanitary wares has lately been brought to such a perfection that they have become strong rivals of the zinc, enamel, and the marmor products. The Ambi-Werke, Berlin have brought out bath and other toilet installations which show a remarkably good finish. Formerly concrete baths for instance were made with a thick wire reinforcement which required comparatively thick walls. The different elongation of the iron and the concrete caused however very often cracks in the concrete under the influence of hot water. Now the walls are made only $\frac{3}{8}$ in. thick, with a thin inlaid wire netting. The new baths are also made in molds and the thin walls are a decided advantage especially as the water in the bath loses little of its heat. Their surfaces are made as marmor terrazzo and they are manufactured in various forms and colors to suit every taste. They are smoothed and polished and are of a fine appearance. The last finish is given to them by polishing the surface with chemicals containing silicic acid. The price of the bath is only about half that of the ordinary enamelled products and its weight is about the same, e. g. 150 to 195 lbs. according to size. The ordinary bath is only polished inside while the outside is painted. They have been used to a great extent in the houses built under Government and municipal schemes. All the goods have preserved their appearances even after long use and have given no cause to complain.



Examples of German concrete sanitary products

Effect of Capping on Strength of Cores

By R. E. Bergford
Assistant Engineer of Tests, Minnesota Highway Department

In making compression tests of concrete cylinders or of specimens of concrete drilled from actual structures, the importance of making the proper correction for the variation in the height of the cylinder relative to its diameter is a factor which has possibly not been sufficiently considered in the past. The necessity for definite information on this question has been felt by the writer for some time in connection with the tests made on cores drilled from pavements in Minnesota.

The diameter of the test specimen drilled is 4.35 in. and the height varies according to the thickness of the slab inspected. Cores are drilled not only from pavements constructed by the State but also from pavements constructed by various municipalities under a great variety of specifications. As is to be expected there is a considerable range in height of cores, heights varying from 3 to 10 in.

Owing to the great range in height of the test specimens, as well as to the more or less irregular surface on the end of the core which is in contact with the subgrade, the problem presented is, first, the best and most economical method of preparing the cores for the compression test, and second, the interpretation of results of compression tests on these cores.

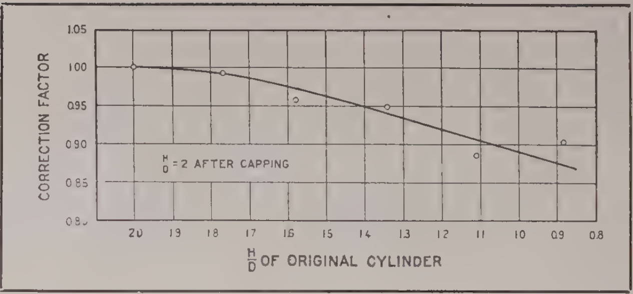
The most satisfactory method of preparing the cores for a compression test would probably be to saw or grind both ends to a square and true surface. As this method necessitates the use of more or less elaborate machinery, the simpler method of capping the ends of the cores with a rich cement mortar has been adopted. The following procedure is used in capping the cores.

Method of Capping Cores

The end surfaces of the cores are first thoroughly brushed and washed in order to remove any dirt or loose material which might be adhering to the surface. The specimen is then placed in a galvanized iron form 4.35 in. in diameter and 8.7 in. high and centered accurately so as to give an equal thickness to the cap on each end.

The mortar used to cap the ends consists of a mixture of 4 parts of portland cement to 1 part of sand by volume and enough water to make the mortar workable.* This mixture when properly cured is found to give a compressive strength greater than that of any of the cores. The capping material is placed in the form, tamped, rounded off with a trowel, and flattened off with a glass plate which is left in position for 24 hours. Damp sand is placed around the edge of the cap and left there for 24 hours in order to prevent checking or cracking of the mortar due to excessive shrinkage. At the end of 24 hours the glass plate is removed and the opposite end capped in a like manner. After both ends of the core have been capped it is placed in a moist curing room and remains there until tested.

The question naturally has arisen as to the correct interpretation of the test results. Very little data are available in regard to correction factors to be applied in the case of compression tests on cylinders of various heights. The recommended shape for a cylinder is one having a diameter equal to one-half its height, i. e., $\frac{H}{D}=2$. The cores as capped in the laboratory have a ratio of $\frac{H}{D}=2$ after they are capped. The variable is introduced by the fact that the capping material is not the same as the concrete composing the core.



In order that we might be able to determine the correct value for the compressive strength of cores thus tested, a series of concrete cylinders was made up, the diameter of each cylinder being 4.35 in., and the heights ranging from 3.7 to 8.7 in. The cylinders which are 8.7 in. high were taken as standard. The remaining cylinders were capped in the manner previously described so that the height after capping was equal to twice the diameter. The mix used in making the test specimens was 1:2:4 by volume. Four different aggregates, including sandstone, trap, gravel, and limestone, were used. The results of this investigation are shown in accompanying diagram, which shows the correction value to be applied to cores of varying heights. Each point in this graph represents the average of tests on 12 cores.

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*Effect of capping on test cylinders.

28-Apartment Building of Lightweight Tile

The accompanying illustration shows a 4-story, 28-family apartment building in Morristown, N. J., built of Hi-Test concrete tile covered with portland cement stucco.

The building is at 20 Community Place and is owned by J. J. Lyons. Tiles were furnished by the New Jersey Concrete Products Co. of Wharton, N. J. Brick masons on the job were very enthusiastic about the tile. The foreman said that men handling the tile for the first time laid better than 450 per day, which is the equivalent of 2700 brick. Interior corridor walls were built of Hi-Test tile as well as the exterior walls.

Long Span Girder Bridge Over the Enz

From article, by W. Stortx, in Baten u. Eisen, Dec. 5, 1924, abstracted by E. Lee Heidenreich.

The city of Pforzheim, Germany, built a bridge over the Enz, in 1922, which in several respects is of original and interesting design. Fig. 1 gives a general elevation of the structure in section, showing a center span of 106 ft., and two side spans of 86 ft. These large spans, and the slim cross section of the piers were necessitated by the exceedingly high water at certain seasons.

The piers are only 26 in. wide, and the girder bridge is supported on them by links indicated in Fig. 3. In addition to serving as a footbridge, the structure carries two 15½-in. water pipes as shown.

The reinforcements of the two girders is shown in Fig. 2, indicating the rods in exact accordance with the bending movements for evenly distributed load, and continuous action throughout the three spans.

To reduce the height of the girders to a minimum, they are connected at the bottom for about 11 ft. each side of the piers, and at the top, for the balance of the span, such connection being necessary, where the positive and negative moments are low. This arrangement permitted the pipe construction to be executed and inspected without difficulty.

The stationary support on pier *A*, one of the center piers, permits expansion and contraction due to temperature changes or other causes being readily taken care of by the other link supports.

The links were constructed of reinforced concrete and cast iron, and the cast iron bearings were reinforced by wrought iron straps.

With a stress of 43,000 lbs. per sq. in. of cast iron upon cast iron, and a load of 338,000 lbs. on the pier, a surface of 17¾-in. radius was required. To distribute this weight on the whole width of the cast iron head, a bending stress in cast iron of 3,650 lbs. per sq. in. was permitted, which gave the pressure on the concrete as 1,460 lbs. per sq. in., necessitating a special cement as well as spiral reinforcing.

The pouring of the concrete directly above the piers was left until the last, so that any settling of the form work could take place before concrete above the piers was poured, where no such settling could occur, and this obviated the danger from secondary stresses due to uneven settling or shrinkage of the forms.

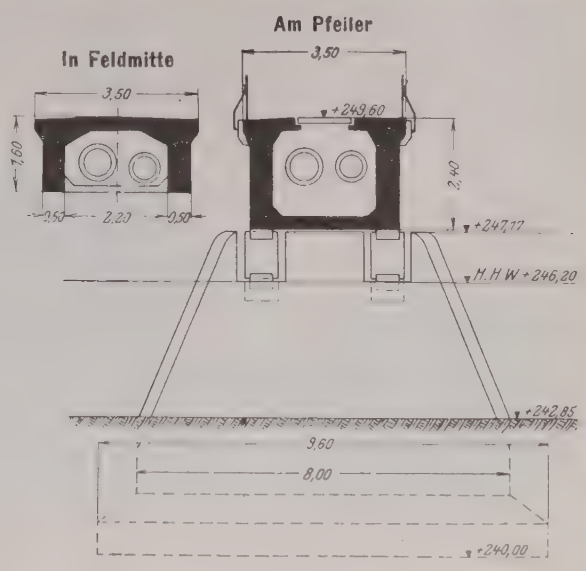


Fig. 3—Sections through girder showing supporting links on piers

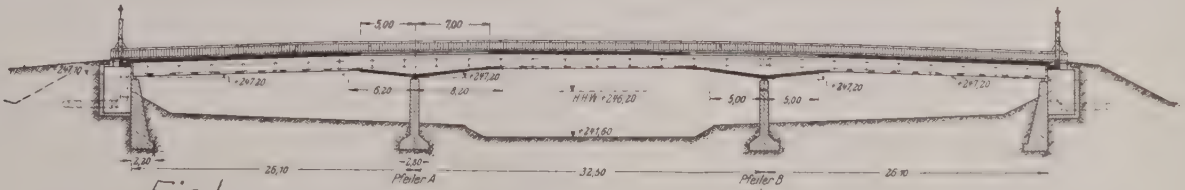


Fig.1

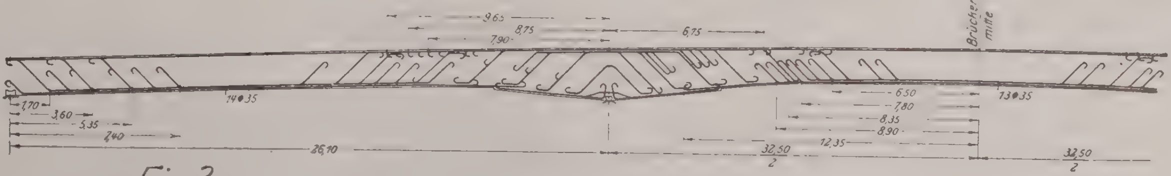


Fig.2

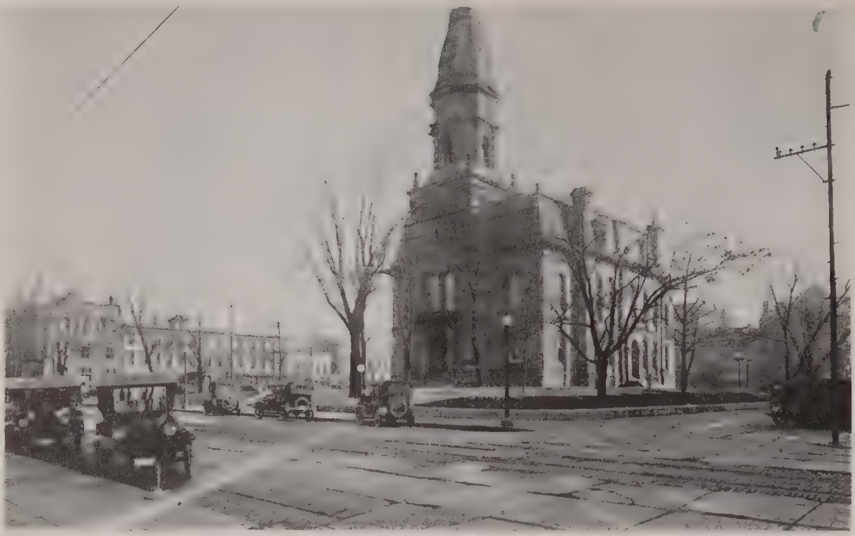
Fig. 1—Sectional elevation showing long span over the Enz

Fig. 2—Detail of steel reinforcement

Crushed Limestone and Tile Waste Good for Concrete

Good concrete can be made from crushed limestone or hollow tile waste, the Bureau of Standards, Department of Commerce, finds. The only drawback to the use of such material is the angularity of the pieces, which makes the concrete flow less rapidly and makes it harder to handle by the methods used in large construction enterprises. This drawback can be remedied by oversanding, the Bureau believes.

Large quantities of waste material accumulate around quarries producing dressed limestone, and the same is true of plants manufacturing hollow tile. An investigation was undertaken by the Bureau of Standards to see if this material could not be used for concrete. Test cylinders were made up, using several standard proportions, and using as the coarse aggregate limestone in some of the cylinders, crushed tile in others, and Potomac river gravel in others. The other conditions were made as nearly the same as possible. In the tests the limestone concrete proved slightly weaker than the gravel, and the tile concrete about one-fourth stronger.



The Court House Square of Bellefontaine, Ohio, paved with concrete in 1892

Oldest Concrete Street Pavement

By A. K. Chenoweth

Probably the oldest stretch of concrete street paving as concrete is understood is that in Bellefontaine, Ohio, four city blocks in extent, put down 33 years ago. The four blocks surround the Logan county court house in the center of the city, on Columbus, Main, Court and Opera streets.

The work was done by W. T. G. Snyder, a contractor and engineer of Bellefontaine, who was called in to make a crossing drive-way for a lumber company—a crossing that would stand up under heavy loads of lumber, coal, etc., and the hoofs of the heavy horses then used to haul the wagons and drays.

Mr. Snyder put in the concrete driveway for the lumber company and it was so satisfactory that his work at once attracted the attention of city officials, later being called upon to put in the street work. The driveway put in during the year 1892 for the lumber company is still in use.

The paving of the streets in Bellefontaine was done under the personal supervision of Mr. Snyder from plans prepared by him and approved by the city officials. In speaking of the work, Mr. Snyder said recently:

"It was not my thought alone that brought about this work but that of myself and the manager and owner of the Buckeye Portland Cement Co. of Ohio. We took the matter up with the city engineer and together formulated plans and specifications for this particular construction.

"The work of building the first concrete paving in the United States and I believe in the world, was done in the year 1892 and was constructed in two courses.

"The first layer was a concrete base composed of one part cement to three parts bank gravel, 4 in. thick when tamped down solid and only enough water in it to bring moisture to the surface. I had men with sprinkling cans of water following the tamping so that if we struck a spot that did not have sufficient moisture to make a thoroughly solidified body, we used the sprinkler and then retamped that portion.

We followed this work by placing a 2-in. topping of concrete, composed of one part cement to two parts of sand, passing a screen of three meshes to the inch. This second course was mixed thoroughly dry, then the water was turned on and it was mixed just wet enough so that you could take a handful of this mixture and press it into a ball and throw like a snow ball.

"In placing this second course upon the concrete, I had men with heavy hand-tampers compact this layer onto the base concrete. When the men found a spot that was too dry to bring the moisture to the surface so that a straight edge or wooden float could not work the surface and carry it forward to fill the uneven places, a man applied water from a sprinkling can so as to give sufficient moisture to surface nicely under the wooden float. We then gave the surface a finish with a steel trowel which was followed up by pushing a small hand roller over the surface which corrugated or perforated the paving to give it a rough surface to prevent possible slipping.

"This work was put in in strips 5½ ft. wide, starting at one street and running through to the next, then going back and putting in another strip until the street was finished.

"This system of doing the work grew out of the way sidewalks were constructed. We used native gravel and sand.

"The first portland cement I used was in the construction of the Bellefontaine water works plant in 1882—an English cement, as at that early date little American portland cement was available. I secured the cement for this work from a Philadelphia company. It was a very fine stone-making cement and we had to learn how to work it as it worked very differently from lime or hydraulic cement which had been used quite extensively in this country for hydraulic purposes up to that time, for such work as making mortar for building cisterns and mortar for stone foundations and for all kinds of stone work.

"As a general rule in these times in using hydraulic cement, we used one-third lime, not to add strength to the mortar but to give it a sticking or plastic quality and to save money as cement cost much more than lime.

"It was about this time, say 1885, when portland cement first came into use in this country, but it was not used in a general way, for several years later. Along about 1888, a company of contractors in Springfield, Ohio, and myself began using portland cement for walks. At this time, there was little known about manufacturing stone from cement. I think that the Springfield firm and myself were about the first in Ohio to adopt this system of making side stone walks out of cement."

"The reason I used cement was because it made nicer work than stone and you could make it conform to any condition

W. T. G. Snyder who did the concrete street paving in Bellefontaine, Ohio, 33 years ago

much more easily than stone. For instance, you could make circular work, such as walks around a building and circle curbing much easier. You would cut out a space for a tree so as not to interfere with the growth and you could finish it either smooth or rough. One of the main objects in such construction was the big saving in money and for the uniformity of surface and the superiority of appearance over stone and for a hundred other reasons that could be enumerated.

"I think all our hard road construction should be of concrete and likely would be if it were not for a few faulty pieces of this type of construction in the past, caused by the use of too much water and by not having the materials mixed properly, and a lack of proper placing on the roadbed.

"One of the most important factors in the construction of this work is an inspector who understands fully and who has had real practical experience along these lines; an inspector who is honest and who will see to it that the work is done properly.

"There is no doubt in my mind that if all the hard surface roads to be constructed were built under the eye of an inspector who would see that no point of the work was overlooked in the construction, there would be no faulty concrete roads.

Through a rather unfortunate political circumstance, little credit has been given Mr. Snyder for the part he had in the making of the first great move in the building of concrete streets and roads. Hundreds of persons from all parts of the known world have visited Bellefontaine, Ohio, in the past twenty-five to thirty years to inspect the paving put down by this man. Few persons have found out the real story back of the paving or the real facts of the construction of this justly famous piece of work. This was due, in part at least, to the fact that politics was permitted to enter into something that should have been placed on record as a real memorial to the progressiveness of one of the first citizens of the city.

The first person who took up the paving to any extent was a Professor Eno, a technical engineer of Ohio State university, Columbus, Ohio. This man made a visit to Bellefontaine and went into the construction of the paving very thoroughly with Mr. Snyder. He took up the matter of the effect of the action of the elements on the cement work, including cloudy weather and sunshine. He was convinced that Mr. Snyder had started something and later made a report on the entire matter, construction and all..

In 1894, a delegation was sent to Bellefontaine from the city of Philadelphia. The men thought so much of the work that they returned and recommended that the city pave all their alleys with concrete.

Engineers from all over the world have inspected the paving and have returned with new ideas from the oldest work of its kind that is known.

Shortly after its construction, a small block of the concrete paving was taken to the Chicago Worlds Fair and years later, in 1915, the Portland Cement Association sent men to Bellefontaine who cut out a block of the street, 5½ by 6 ft. for shipment to the fair at San Francisco.

The paving is still in use as shown by the illustration from a recent photograph. A traction line was built through Bellefontaine several years after the work was done, necessitating cutting out the street for the tracks and filling in with brick as may be seen.

Connecting Concrete Beam to Steel Column

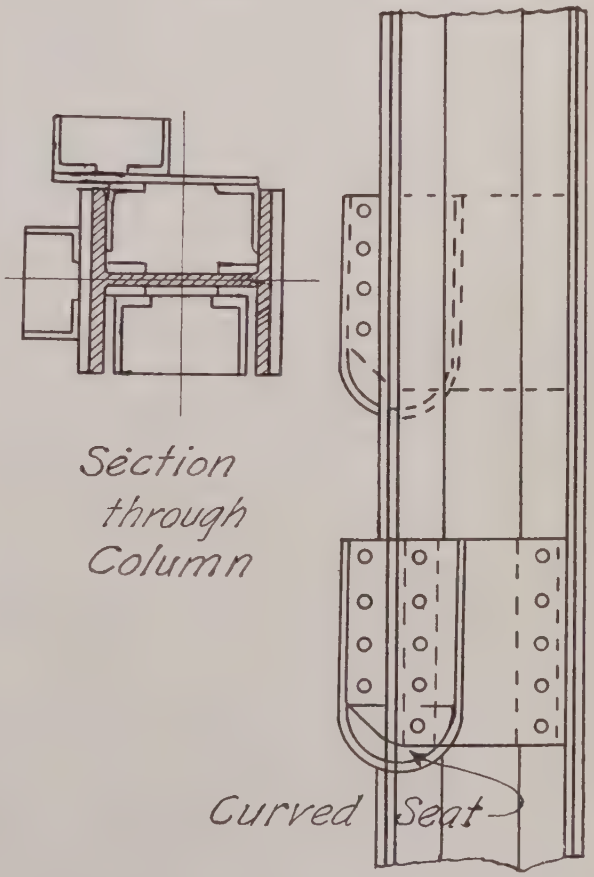
The problem of connecting a concrete beam to a steel column presents some difficulties because the concrete beam, being relatively weak in bearing as compared to a steel beam, requires a wide stiff bracket which is often objectionable from an appearance standpoint and expensive to fabricate.

This problem has been solved as shown in the accompanying sketch by Elwyn E. Seelye, a consulting engineer, 101 Park Ave., New York City, through the use of a hanger made from an angle with a curved seat to equalize the pressure.

Its application to eccentric beams is illustrated.

Variations in loads are provided for by increasing the size of the angle and if necessary the use of a curved plate.

This seat has been patented by the designer, who recommends it because of its simplicity and foolproof qualities.



Sketch showing method of connecting a concrete beam to steel column

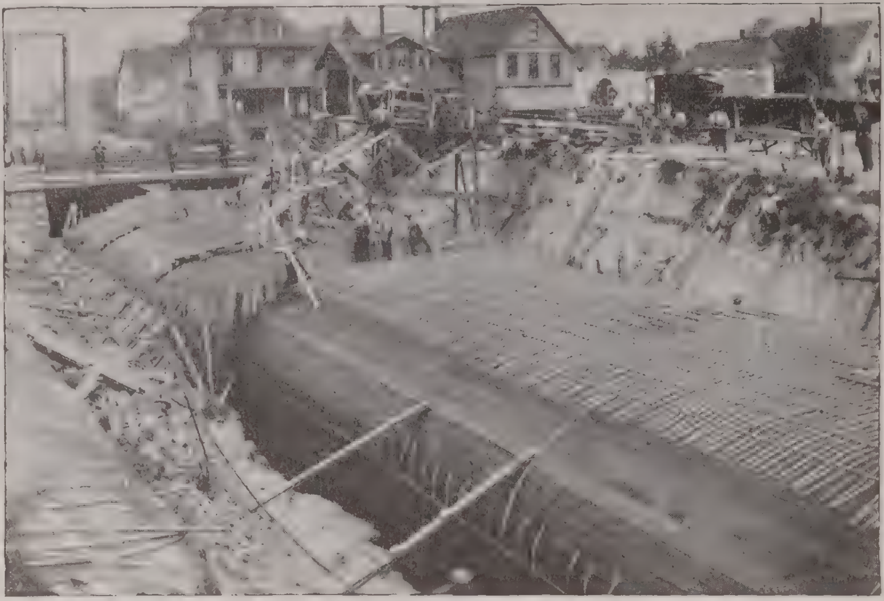


Fig. 1—Pouring concrete on one section of drain Forms and reinforcement being placed for advance section. Concrete chuted from conveyor belt to forms

Trucks and Conveyor Deliver Concrete to Sewer Forms

A notable piece of concrete construction is being done on the conversion of the Scajacwada Creek in Buffalo, N. Y., into a great stormwater drain. For some years the creek has subjected the citizens of the northeast section of the city to considerable inconvenience by periodic overflows during storm periods, and one of the first projects of the City Planning Commission was for the regulation of this stream. The first section of the work, completed two years ago, at the outlet of the creek into Park lake presented no very unusual features, but the second section, now under construction, offers some novelties both in the handling of the concrete and in the way the unusual difficulties of the job were overcome.

The section now under construction is 7800 ft. long, its inside width varying between 33 ft. 6 in. and 29 ft. 6 in., the maximum width representing the influx of the great stormwater drain at Delaware Ave., where the flow is between two and three hundred second-feet during storms. The drain is being provided with a 7-ft. vertical retaining wall bearing a semi-eliptic arch with a 7-ft. rise at the center.

As the drain rests on rock throughout, the thickness of the vertical walls is only 16 to 18 in., most of the thrust of the arch being taken up by the rock base. The arch is 20 in. thick at the crown and 41 in. thick at the haunch at one point where the drain is crossed by a railroad track, the normal thickness being considerably less.

The construction is reinforced concrete throughout, the work being built in 57-ft. sections. The reinforcing consists of 5/8-in. steel rods. At one point these rods are spaced 4 to 6 in. on centers and average 40 tons to the 75 ft. section. The normal spacing is 8 to 12 in., depending upon the load, the calculated maximum load being 1000 lbs. to the square foot on top of the drain.

The concrete is mixed in proportions of about 1:5, the aggregate being Niagara river sand and gravel. To economize on occupied space and to concentrate the mixing, a single concrete mixing plant was constructed, about midway of the job. This plant was located close beside a railroad siding, where there is convenient water connection.

The Mixing Plant

The gravel is delivered from railroad cars, being dumped in a pit at the west end of the mixing plant. An endless belt with buckets descends into this pit and lifts the gravel to the storage hopper above the double mixer. These hoppers will hold approximately four carloads. Below them are batch hoppers, into which are released 25 cu. ft. of sand and gravel, and from five to six bags of cement, depending upon the quality of the particular batch of gravel.

The mixers have a capacity of 1½ yds. and deliver the mixed concrete to trucks, which are specially fitted with double containers to carry the concrete. The trucks in turn deliver their loads at the job to a hopper discharging onto an endless belt conveyor on the bank of the stream. This conveyor carries the concrete to the job, and when a section directly under the end of the conveyor is being poured, discharge it through spouts to the forms. As the sections progress, the use of spouts is no longer possible, and the conveyor is then terminated in a small hopper, which delivers the concrete to another endless belt running the length of the job.

The longitudinal belt conveyor is 300 ft. long, and is so arranged that it can be moved back and forth along the forms, thus making it easy to start at either end of a 75 ft. section and pour the concrete accurately on any portion of the section. The whole conveyor is moved back and forth as the work progresses. Both belt conveyors are operated by a 10 h. p. gasoline motor, and another motor is kept constantly in reserve in case of breakdowns, as serious damage might result if the pouring were halted during the construction of a section.

When the extreme range of the longitudinal belt conveyor has been reached, the shorter conveyor at the river-bank is moved down to center on another 300-ft. section and the process is repeated.

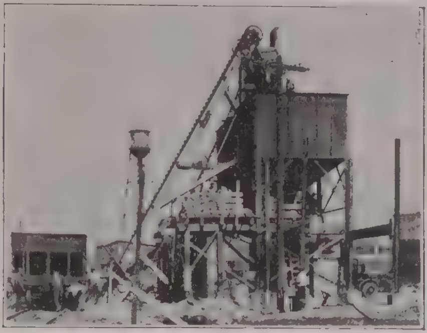


Fig. 2—The central mixing plant with elevated bins filled by bucket elevator

The results from this system have been most satisfactory, far surpassing anything attained with portable mixers, the more so since the process is so largely mechanical, and there is hence a considerable saving in labor. A check on time shows that from the moment the concrete is released from the mixer to the moment it is poured on the job at the extreme end of the longitudinal belt conveyor, the time consumed averages six minutes. It is not planned to carry the concrete work on during cold weather, and it is also discontinued during storm periods, when the flow of water is so high as to hamper the work.

Streets cross the drain in several places and it is planned to pave over a portion of it so it can be used as a roadway.

The heavy reinforcing represents the point where the drain passes through the property of the Buffalo Foundry Co. and under two railroad bridges on the company's sidings. The buildings of the company are on both sides of the creek. One of the bridges was supported by a central pier, which had to be removed. When the work is completed, the bridge will rest on the drain, and to provide for the loading at this point, the section has been specially strengthened.

When the excavation was complete, it was discovered that the second bridge, of free span construction, rested on concrete abutments which in turn rested on 4-ft. piles. It was necessary to remove the earth around these piles, and place concrete underpinning under the abutments, which was very deftly accomplished, in spite of the constant passage of heavy railroad cars on the bridge above.

Economic Value of Road Reinforcement

In the early fall of 1924, the Highway Research Board was requested to conduct a nation-wide fact-finding survey on the economic value of reinforcement in concrete roads. This request was urged not only by engineers, but also by certain interested agencies who felt that such an investigation was necessary to determine the trend of future manufacturing conditions. Under the policies of the National Research Council, industries are encouraged to contribute to the cost investigations of this kind, and this plan is being followed in this survey.

For conducting this survey, the Highway Research Board has secured the services of C. A. Hogentogler, an expert research engineer, who has had much experience in practical highway work and is the author of numerous research articles.

In this study an effort is being made to determine from a survey of existing roads, the influence of steel reinforcement on the resistance of the slab to traffic; of subgrade; of climatic conditions; of the conditions under which steel reinforecment is especially beneficial to concrete slabs; of the effect of slab design on the efficiency of reinforcement; and finally, of the relative cost of plain and reinforced concrete roads, considering the initial investment together with the annual maintenance and renewal charge.

Final conclusions will be based on results of highway experiments, reports of previous road surveys and maintenance and construction costs correlated with the present condition of road surfaces that have been in service from one to twelve years. The survey is mainly confined to surfaces containing considerable lengths of both plain and reinforced sections of the same age, design and traffic conditions. Surfaces conforming to these requirements have been located in about thirty states, ranging from Connecticut to California, and Minnesota to Texas.

Upon the completion of the survey, a comprehensive report of the findings will be issued.

Concrete Water Tower

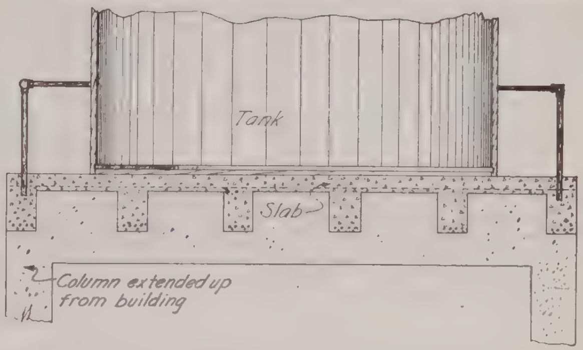


Fig. 1—Sketch showing slab and beams upon which water tank rests, and the supporting columns extended up from building

In the recent erection of a fireproof building for the McCord-Kistler Mercantile Co., at Emporia, Kans., a reinforced concrete water tower to support a tank that surmounts the building was built after a simple design as shown in the accompanying sketch.

The floors and roof of the building were constructed of reinforced concrete, supported by columns about 18 ft. from center to center. The outside columns were connected with reinforced beams at every floor line which supported the brick curtain walls that were built between the columns in order to enclose the building. The beams and columns being exposed, gave the sides of the building a panel effect. The fire-walls were built of brick with copings to match the beams and columns. While the building was of a very plain serviceable construction, it nevertheless had a very pleasing appearance when completed.

The building was equipped throughout with an up-to-date system of automatic fire extinguishers, and in order to get the required amount of water pressure it was necessary to have an elevated water tank. The tower for this tank which was 40 ft. above the roof of the building, was constructed of concrete, and comprised an extension of four interior columns above the roof. The footings for the four columns that form the tower, were designed so as to carry the extra weight and the columns were likewise made larger in proportion. At each succeeding story of the building, these columns were reduced in cross-section. Beyond the roof they were tied together with reinforced concrete beams at what was called the future floor lines. The water tank rested on a concrete slab that was supported by reinforced concrete beams.

The M. J. Leeper Construction Co. had the contract for the work.

Curing Concrete With Calcium Chloride*

By C. L. McKesson

MATERIALS AND RESEARCH ENGINEER, CALIFORNIA HIGHWAY COMMISSION

*From *Public Roads*

One of the difficulties attendant upon the construction of concrete pavements in the drier regions of California is the expense of securing water for curing the concrete for two weeks after laying. It has long been known that calcium chloride, under favorable conditions, will absorb moisture from the air and, during recent years, experiments have been made in an effort to utilize this chemical as a substitute for ordinary water curing. Illinois, with a rather high relative humidity and precipitation throughout the year, reports considerable success in the curing of concrete by distributing 2½ lbs. of calcium chloride per square yard soon after the concrete is finished.

During the last year the California Highway Commission has conducted extensive field and laboratory experiments in an endeavor to ascertain whether this substitute can be used safely in California in sections where humidity is low, temperature high, and precipitation absent during summer months. Field experiments were conducted on paving jobs in Los Angeles, Ventura, Sacramento, and Humboldt Counties.

Preliminary experiments made early in the season indicated that a slight reduction in strength would probably result from the substitution of calcium chloride treatment for the usual water curing and all of the field tests made during the summer bore out this conclusion.

On two of the projects concrete specimens 6 x 6 x 12 in. were cast from the concrete actually used in the pavement. In each case half of the specimens were cured by placing them on one side the morning after they were made and by applying flake calcium chloride (dry) at the rate of 2½ lbs. per sq. yd. of surface. The other half were water cured. On three jobs, a portion of the pavement was treated in a similar way with calcium chloride and the remainder was cured with water in the usual manner. After the completion of the work cores were drilled from the pavement cured by both methods. The cores were tested by the State highway laboratory at Sacramento.

Following is a summary of the results of the tests and relative efficiency of calcium chloride curing as indicated by them.

Location of experiment	Number of samples	Average compressive strength					Remarks
		6x6x12-in. molded specimens		4½-in. cores from pavement		Efficiency of calcium chloride[1]	
		Cured with water	Cured with calcium chloride	Cured with water	Cured with calcium chloride		
				Lbs.	*Lbs.*	P. ct.	
(X-Sac.-4-B) Sacto-Stockton highway, near Sacto.	24	......	......	4,292	4,218	98	Hot and dry (water-cured concrete 57 days old. Concrete cured with calcium chloride 70 days old).
(VII-L. A.-2-BO) Ventura-Los Angeles highway near Calabasas.	32	3,064	2,783	......	......	91	Hot and dry.
	28	......	......	4,057	3,294	81	
(VII-Ventura-2-A) Los Angeles highway near Newbury Park.	12	......	......	3,491	3,093	88	Hot and dry.
(I-Hum.-1-GH) Eureka - Arcata highway at Arcata.	72	3,887	3,545	......	......	92	Experiment in October. Weather cool, humidity high (70 to 90 %). Some rain.

[1] Efficiency of calcium chloride curing, assuming water curing to be 100% efficient.

The above tests indicate that calcium chloride is from 80 to 90% efficient and that it might be used as a substitute for water curing where water is scarce. Some of the strength appears to be sacrificed, but the cores showed a minimum average strength of more than 3,000 lbs. in the most unfavorable case, and this strength indicates a fair factor of safety.

A very extensive series of curing tests not included in the above discussion was conducted at Sacramento during the summer and fall of 1924 by the California Highway Commission in cooperation with the Structural Materials Research Laboratory of Lewis Institute. Calcium chloride and many other methods of curing were included in this series, the results of which will be given to the public in a report now being prepared.

Residence Construction Requirements

The report of the committee on building construction, specifications for private residences of the National Fire Protection Association which has just been issued is a complete and for the present, at least, a final report covering all grades of private residence construction. It constitutes a consolidated revision of the Association's previous progress report, combined with this year's work. The complete report as presented comprises seven parts as follows:

1. General Requirements: This consists of classification of residences, definitions, materials and methods of construction applicable to all types of residence buildings, also installation of heating apparatus and gas and electric equipment.

2. Private Residences—Grade A: Presents specifications for construction and service equipment of the highest type of fire-resistive private residences. No combustible material allowed in the construction, and, if fully equipped with automatic sprinklers, no limit is placed on height or area. All rooms containing special hazards required to be protected by automatic sprinklers.

3. Private Residences—Grade B: A highly fire-resistive building erected of incombustible materials except that wooden doors, windows, surface flooring and trim are allowed. No restrictions as to height or area when fully equipped with automatic sprinklers. All rooms containing special hazards required to be protected by automatic sprinklers.

4. Private Residences—Grade C: Incombustible construction required for all walls, floors and bearing partitions. Non-bearing partitions may be of wood studs with incombustible finishing. Doors, windows, trim and surface flooring permitted of wood.

5. Private Residences—Grade D: Incombustible construction required for all walls. Interior framing permitted of wood. This grade corresponds to what is generally known as joisted brick or ordinary construction.

6. Private Residences—Grade E: Permits exterior walls of wood framing covered with masonry veneer or stucco. Interior construction similar to Grade D.

7. Private Residences—Grade F: Frame construction permitted throughout, but contains many fire-resistive features not usually found in buildings of this type.

The general scheme of the several specifications is to allow greater height and area and the removal of various restrictions in proportion to the improved interior finishing and the increased fire resistance of the construction progressively applied from Grades F to A.

The Road Builders

The Annual Convention and Road Show of the American Road Builders' Association will be held January 11-15, 1926, in the Coliseum and adjoining buildings in Chicago. W. H. Connell, engineering executive and deputy secretary of the Pennsylvania Department of Highways, the the new president of the association, has announced that the convention will be carried on in two divisions, one covering the engineering side of road building, and the other the construction side. These two divisions of the convention will be in session simultaneously in adjacent rooms. By handling the program in this manner, those interested in engineering can devote their entire time to engineering subjects, while those whose main interest is in construction may keep their attention fixed on that phase of the work.

Concrete Pipe for High Pressure Work

By Major Johnstone-Taylor
ENGLAND

The advantages of concrete as a material for pipes has been recognized to a considerable extent of late. For large conduits conveying water by gravity—sewers for instance—the construction either partakes of cast sections with slip joints or continuous construction by orthodox methods. In the case of pressure pipes, however, various methods have been introduced among which may be mentioned the lock joint system of American origin, the Bonna pipe introduced by a Belgian engineer and the Hume centrifugal process. The latest comer in the field is that under review and is known as the Ferconbar.

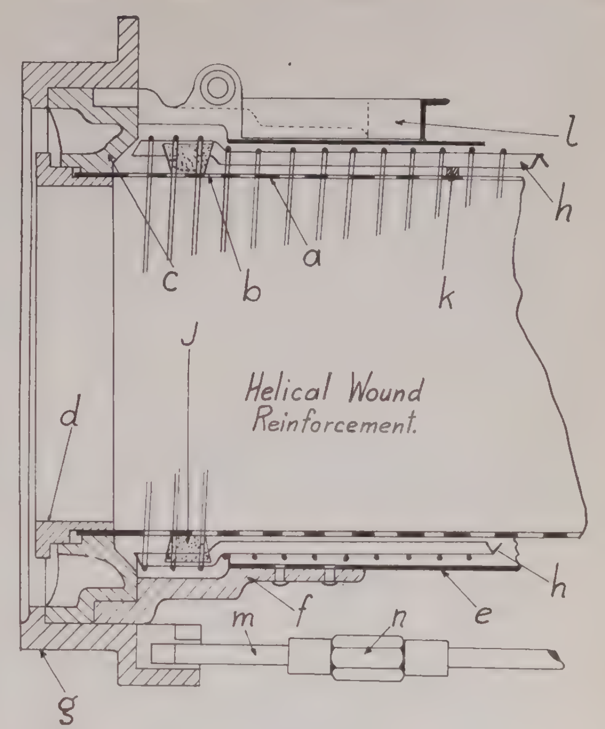
It must be borne in mind that the successful operation of a concrete pipe under high pressure depends not only upon the retention of uniform pitch of the helical wire reinforcement when wound but also the fixation within the pipe wall of the helix or cage in predetermined position during the process of manufacture while the uniform covering of the whole with concrete is most important. It is upon these considerations that the following method of fabricating has been introduced.

FABRICATING THE PIPES

The essential feature of the system is the method whereby the reinforcement is mainly helical and moreover is wound to a definite and accurate pitch. The arrangement is shown in the accompanying diagram. First of all there is a metal core shown at *a*. It constitutes the initial supporting element and may be built up of three or four longitudinal segments. Through the numerous perforations *b* the concrete is introduced. The core is mounted in seat *c* being clamped up by locking ring *d*. Mold *e* and mold castings *f* should be noted. Then there is roller path *g* which being mounted on friction rollers transmits the rotational movement necessary. So much for the general equipment.

REINFORCEMENT

Behind core *a* are a series of stamped steel reinforcement retainers *h* running longitudinally the length of the mold. These are of V section. Molded on to the ends of these bars are concrete blocks *j* the purpose of which is to retain the concrete within the mold. The members *h* are supported at intervals between the ends either by concrete blocks or more usually by ribs *k* affixed to the core segments. The core then with its seat and stiffeners—the latter take the form of light metal spiders located at intervals within the core—are assembled and clamped up by temporary end clamping discs tied by a central bar. This is mounted between the centers of the winder. This is arranged so as to enable the supply of wire to be traveled at a uniform pitch and to be fed through tension means so that an adjustable and uniform strain is maintained throughout. This tension is sufficient to prevent movement of the "fercon" bars *h*. The wound core and seats are now removed to the molding machine where they are housed within mold castings *f* united to the outer shell *e*. This is divided into three or more segments provided with angle irons *l* for bolting together, these parts of the rotor being positioned by annular roller paths *g* held together by bars *m* drawn up by turnbuckles *n*. Between mold and core the concrete is now placed by centrifugal means. The arrangement of the reinforcement and the method whereby it is set up ensures that its position relative to the core and mold is absolutely definite and absolutely rigid before the concrete is poured while the centrifugal casting ensures the necessary density of the concrete. The resulting product is a pipe which will stand considerable internal pressure and the interior being finished with fine concrete mortar the pipes have a smooth non-corrodible bore so essential to water conduits but unobtainable with any iron or steel pipe.



Details of section of new Ferconbar concrete pipe

Crushed Limestone and Hollow-Tile Waste Aggregate

Often a considerable amount of waste accumulates at quarries producing dressed limestone, and similar conditions exist at plants manufacturing hollow building tile. In an investigation of possible uses for these waste materials the Bureau of Standards recently carried out a few tests on concretes in which they were employed as coarse aggregates.

Forty-five 6 x 12 inch test cylinders were made in which Potomac river sand was used as fine aggregate, and Potomac river gravel, tile waste, and limestone waste were used in one-third of the cylinders as coarse aggregate. Three proportions by volume, 1:2:4, 1:2½:5, and 1:3:6, were used for each coarse aggregate. The coarse aggregate was crushed, and only that proportion between the No. 4 and 1½-in. sieves was used. All mixes were brought to the same flow of 90 as measured by the flow table. To obtain these flows the amount of water by weight of the total dry materials was 9.7% for the gravel aggregate, 13.8% for the limestone aggregate, and 15.4% for the tile aggregate.

The specimens were stored in the damp closet, and were tested at the age of 28 days. The strengths developed by the 1:2:4, 1:2½:5, and 1:3:6 mixes, respectively, for the gravel concrete were 1,680, 1,185, and 835 lbs./in.^{2}. For the tile concrete the corresponding strengths were 2,070, 1,328, and 957 lbs./in.^{2}, and for the limestone concrete they were 1,525, 972, and 777 lbs./in.^{2}

The results of the tests indicate that in so far as strength is concerned these materials are suitable for coarse aggregates in concretes. However, both materials produced rather harsh working mixes as compared to the gravel mixes, and in order to secure ease in handling and placing of these concretes it probably would be well to use over sanded mixes.

Expanded Concrete

Gasconcrete is a new building material which is patented in Sweden and a number of other countries and patent applied for in the United States. It is made of portland cement, aggregate and a small addition of aluminum powder. When water is added to this the hydrogen and the oxygen of the water are freed. Gas makes the mass assume a very much larger volume. The concrete hardens in this state and becomes a porous material, which after a day or two can be cut easily into building blocks according to requirement. The hardening process continues for several weeks as with any properly mixed concrete. The material can be sawed and planed and nails may be driven into it.

In Sweden it is allowed by the building authorities for bearing walls of one and two-story buildings in thicknesses of 6 in. or more at the usual mixture of at least 40% cement to 60% shale lime, and for working stresses of not more than 43 lbs. per square inch. After six weeks the material attains a strength of about 350 lbs. per square inch. For filling in walls it may be used for any height. It was recently used for the walls, outside of columns, for a 17-story building in Stockholm.

The material is very light. The usual mixture weighs only about 45 lbs. per cubic foot and floats in water. It is a very good insulator against heat and cold and sound. It is said 6 in. of this material will insulate as well as a brick wall 18 in. thick and solid concrete wall 32 in. thick. As a result of this, walls may be made thinner. In Stockholm, walls of this material 6 in. thick will be allowed where brick walls 16 in. thick would be required. This means a great saving in material, labor and space. Owing to its lightness the material may be furnished in large blocks, easy to handle. It is said to stand up well against frost and humidity and holds the finish or stucco very well and may be planed off in advance, so as to take very little finishing material. Its weight may effect savings also in the foundations, columns, girders, etc. This information comes to CONCRETE from J. Engh, representing the patent owners.

K. P. BILLNER, writing in *Concrete and Constructional Engineering*, London, says of "Expanded Concrete":

> The only country where expanded concrete is being manufactured to any extent is Sweden, where the material is now being manufactured by four different firms.
>
> It is possible in this manner (the admixture of an alkaline metal) to produce a concrete so light that a cubic foot weighs only 20 lbs. (compared with 130 lbs. per cubic foot for ordinary concrete). The strength, however, decreases rapidly when the material is made very light. For building purposes a material weighing about 42 lbs. per cubic foot is most suitable. At this weight the ultimate compressive strength averages 400 to 500 lbs. per sq. in. This allows for a safety factor of about 10 when the material is used for walls in two-story buildings.
>
> The texture of the material resembles that of cork. It is full of small and evenly distributed cavities, which make up 70% of its volume. Each one of these cavities is a closed compartment surrounded by thin walls, and this is the reason the material has such exceptionally good insulating qualities. Thorough tests have been made under the auspices of the Swedish Academy of Engineering Science in order to ascertain the amount of heat transmission through walls of this material in various thicknesses. The heat insulating properties of expanded concrete are more than three times greater than those of brick, and seven times greater than those of ordinary concrete.
>
> The material can be made either in blocks or it can be cast *in situ*. If the latter method is employed the following advantages accrue: (1) Unskilled labor may be used, (2) there will be no mortar joints in the walls, and (3) the walls may be reinforced. The author has made a series of tests in order to ascertain the amount of adhesion between expanded concrete and steel reinforcement, and he has found the bond to be proportionate to that which takes place between steel and solid concrete. It is therefore possible to make beams for spanning over door and window openings instead of arching them. The material can also be used for floor construction, and such floors are considerably lighter than ordinary reinforced concrete floors.
>
> Another advantage of expanded concrete is that it can easily be worked with common wood-working tools. It can be sawed, and grooves can be made in it for electric and other conduits. In this respect, and also in respect to protection against heat or cold, it is greatly superior to hollow concrete tiles. A building of this material does not weigh more than half as much as a brick building of the same proportions. Expanded concrete can be made at about the same price as ordinary concrete of equal volume.
>
> The credit for the lead which Sweden possesses in the development of this building material should be given to the architect Axel Ericson, who first worked out a process for its manufacture.
>
> A house built of expanded concrete has been built in the Housing Section of the Palace of Engineering at the British Empire Exhibition, and the material has been tested by Messrs. Holland & Hannan and Cubitts, Ltd., in whose laboratory pieces of expanded concrete have been floating in water for over five weeks without any signs of absorption. Samples of the material have also been brought to red heat and then immediately immersed in water three times in succession, the only result being a crumbling of the surface.

Along a similar line is this from Austria:

The Hungarian concrete expert Josef von Vass for years has carried on tests to overcome difficulties of heat and sound conductivity in concrete and has recently published the results of his experiments.

The most effective of his proposals appears to be the method in which the concrete is mixed and wetted in an enclosed vessel under air pressure, the pressure being gradually reduced and the material permitted to flow out.

The manufacturing cost of L shaped Ambi Brick (5 cm. thick, 30 cm. high, 50 cm. outside angle length) with 35% air contents are said to be lower than that for ordinary brick. The saving is largely due to the fact that the porous brick requires about 25% less material.

Politics and Concrete

P. & A. Photo.

Pat Brown, of Hillyard, Wash., shown in the picture, was elected Mayor of Hillyard on a non-white collar platform. He is probably the only wheelbarrow pushing Mayor in the country. Besides running the city council, leading the anti-annexation movement against becoming a part of Spokane, and working as a concrete mixer, the Mayor is a thumping good blacksmith and his smithy is the "back room" of the municipalities' political circles.

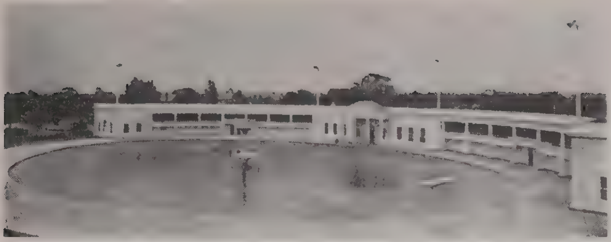


Fig. 1—The completed pool

Building a 1,500,000-Gallon Pool

The pictures show construction views of a 1,500,000 gal. swimming pool—210 ft. from end to end and 160 ft. in its shorter diameter; depth, 6 in. to 10 ft. 6 in., at Idora Park, Youngstown, Ohio. The work, done by the Heller-Murray Co., Youngstown, involved some unusual features.

This open-air pool will accommodate a maximum of 4000 bathers. There is a diving tower with two levels, for low and high diving, rising from the center of the pool, reached only by experienced swimmers.

The building combines dressing rooms, filtration and purifying plant, laundry, and spectator's balcony, and extends around one-half the pool. Shower baths are placed at each entrance of the bath house.

It is fed by twenty-six 2-in. water mains around the edge, or by five 6-in. mains in the bottom, the direction of flow being reversed at will. A complete change of water will be made every 20 hours Water is supplied from the city water mains.

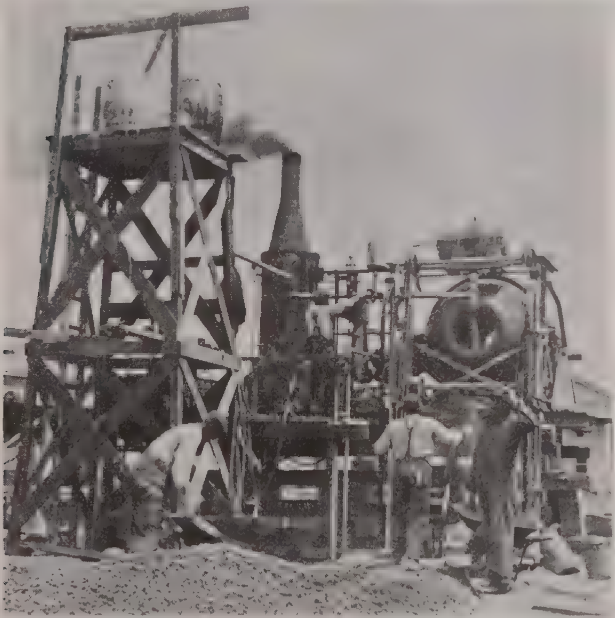


Fig. 2—The mixer plant

An elaborate system of maintaining purity of the water at all times has been worked out.

One-half of the pool rests on an excavated area, the other half on filled ground, and the latter is reinforced. The concrete is waterproofed by the integral method, using General Fireproofing paste.

This material was introduced into the mixing water supplied to each batch. Proper proportions of paste to water and cement were controlled by a special mixer set-up, which is illustrated. A platform above the mixer supported two barrels, connected by a 2-in. pipe to a measuring tank placed conveniently near the mixer drum and at a slighlty higher level. The measuring tank was in turn connected to the water supply pipe leading from the mixer tank. Valves, placed at the proper points, controlled the flow of the waterproofing into the measuring tank and from the latter into the water supply line to the mixer. The paste was mixed in the barrels in the proportion of 1 gal. of the paste to 5 gals. of water. This was done by first putting 8 gals. of the waterproofing paste in each barrel and filling up to a mark with water. The measuring tank was kept filled, and, as indicated by an attached water gauge enough of this mixture was then let into the mixer to give 1 gal. of the waterproofing solution to each bag of cement used in the batch. To be sure of the right proportions, the barrels were mixed and emptied in rotation. Each barrel of solution was sufficient to waterproof $8\frac{1}{3}$ yds. of concrete.

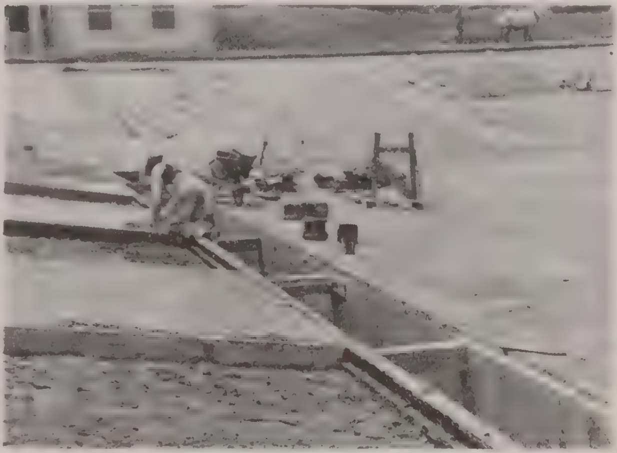


Fig. 4—Detail of construction; placing alternate sections

A unique feature of the operation was the method by which the concrete was transported to the point of use. A circular plank track was laid around the pool, and on this a Ford truck with a hopper carried the concrete wherever required. This eliminated the necessity of erecting a tower and chute, and the mixer remained in one location.

The concrete was laid to a thickness of 6 in., in sections of convenient area for working, floated and trowelled. Joints between sections and all openings around pipes, etc., were sealed with a G. F. mastic.

Consulting engineers were Lynch Bros., New Haven, Conn. Engineers in charge of construction were E. P. Harrington and F. W. Stamboro, of the Heller-Murray Co.

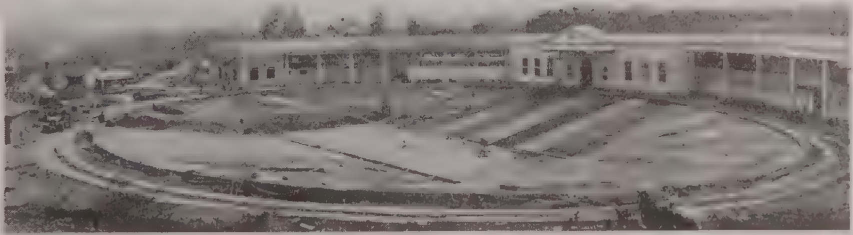


Fig. 3—The pool under construction

Manufacturing District Makes Own Brick

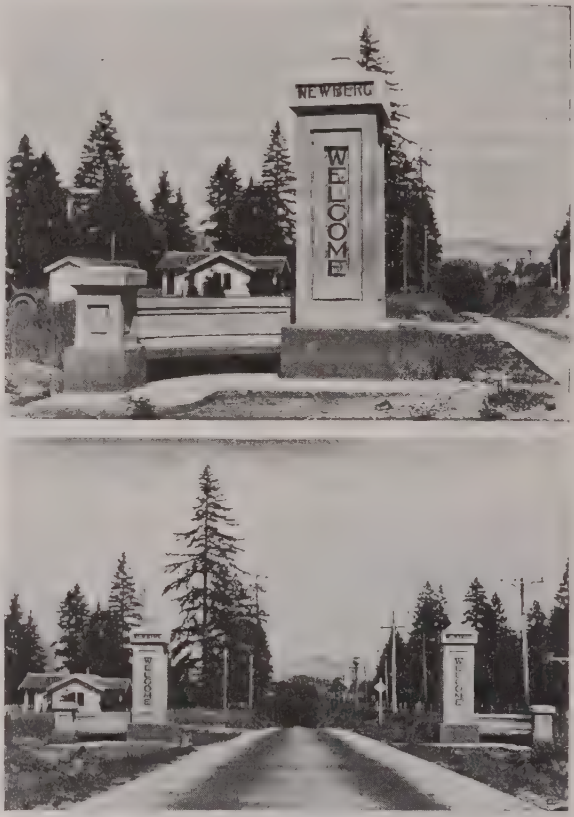
The Central Manufacturing District of Los Angeles is a complete industrial community—so complete and self-contained that, in addition to other facilities, it manufactures, right on its property, the brick, both common and face, that is used in the construction of its factories and warehouses. It was organized in 1923. In the bed of the Los Angeles River, along one side of the property, the proper grade and quality of sand needed to manufacture a good grade of concrete brick was found.

"Since the beginning of actual building operations in July, 1923, the District has had in actual use on its property a No. 5 Helm brick press, turning out 15,000 common brick daily," says E. P. Querl, of the Central Manufacturing District, Inc. "This average has been consistently maintained throughout the entire period, and is expected to be kept up during the years to come as long as building operations are continued." Mr. Querl continues:

> In addition to the foreman, the District employs in its brick-making department two pressmen, a man for mixing, one for molding, two for stacking on pallet rest, and one for unloading from pallet rest and stacking on piles after being cured.
>
> This force of eight men has been kept steadily employed, and, as stated, has manufactured 15,000 common brick each day. Of this number, one-third—or 5000 brick—out of each day's output are faced. Nothing but face brick is used on all fronts of our buildings, and in many cases, especially where the building runs along a side street, face brick is used on one or more sides.
>
> All bricks have to be up to standard. In order to keep a close check on the maintaining of this standard, bricks are tested regularly by the Raymond G. Osborne Laboratories, of Los Angeles.
>
> The sand secured from the Los Angeles River is a good grade of ordinary river sand which, during the summer months, is fresnoed out of the river bed. During periods of high water in the late fall and winter months, this sand is sucked out of the river by means of centrifugal sand pumps.
>
> The Central Manufacturing District of Los Angeles is patterned after the Central Manufacturing District of Chicago, and is backed by the same capable, experienced men. The Chicago District is now the home of nearly three hundred industries, while the Los Angeles District, during the brief period of its existence, has more than a score of progressive companies manufacturing and warehousing on its property.
>
> This District has all such facilities as gas, electricity, water power, sewer system, paved streets, express, telegraph, telephone, mail and banking service, in addition to its railroad, trucking, brick-making, etc. A neutral belt line road, the Los Angeles Junction Railway, is owned and operated by this company, and gives its industries free switching service from all main lines entering the city.
>
> There are terminal facilities of over 200 acres of land out of the congested area of Los Angeles and on paved highways leading to the Harbor and cities to the south and east.
>
> The Company was organized for the specific purpose of bringing to Los Angeles the type of industries needed to build up this city into a manufacturing center.

Costs on the manufacture of common brick, while not as low as they should be, effect a considerable saving in construction work. With cement at 65¢ net per sack; sand costing us nothing except the labor of fresnoing it out of the river; common labor, 50¢ per hour; pressman labor, 65¢ per hour; and foremen $45 per week, and overhead costs, interest on investment, depreciation, insurance, etc., all aggregated give production of common brick at $11.25 per thousand. Face brick costs approximately $26 per thousand, as compared with a market price on common brick of $15.00 per thousand, f. o. b. the Manufacturing District tracks, and face brick at $45.00 per thousand. Hauling costs on concrete brick average $1.50 per thousand on common and about $2.00 per thousand on face brick from our yard to building construction. The brick yard is to be moved to a better location and with a new layout.

Welcome to Newberg



The Newberg, Oregon, city gates are on the Westside Pacific Highway and were erected by Newberg civic clubs to advertise the town. The work was done by Harlan Smith, Newberg contractor.

The pillar bases and lower parts of seats are plastered over the poured concrete with one part of Oregon portland cement (of dark color) and two parts of Columbia river sand with two pounds of Germantown lamp black coloring to each barrel of cement. The pillars and seats from the bases up were plastered with one part Sun portland cement (of light color) to two parts Columbia river sand and 15% hydrated lime and troweled smooth. There is a metal door in each large pillar on the side that the seat joins, 16 in. wide and 5 ft. long, the form for door of ⅜ x 1 in. iron and covered with 20-gauge galvanized iron, hinged and locked. The door is painted to match the pillar. Bases of main piers are 4 ft. wide and show 2 ft. above sidewalk level.

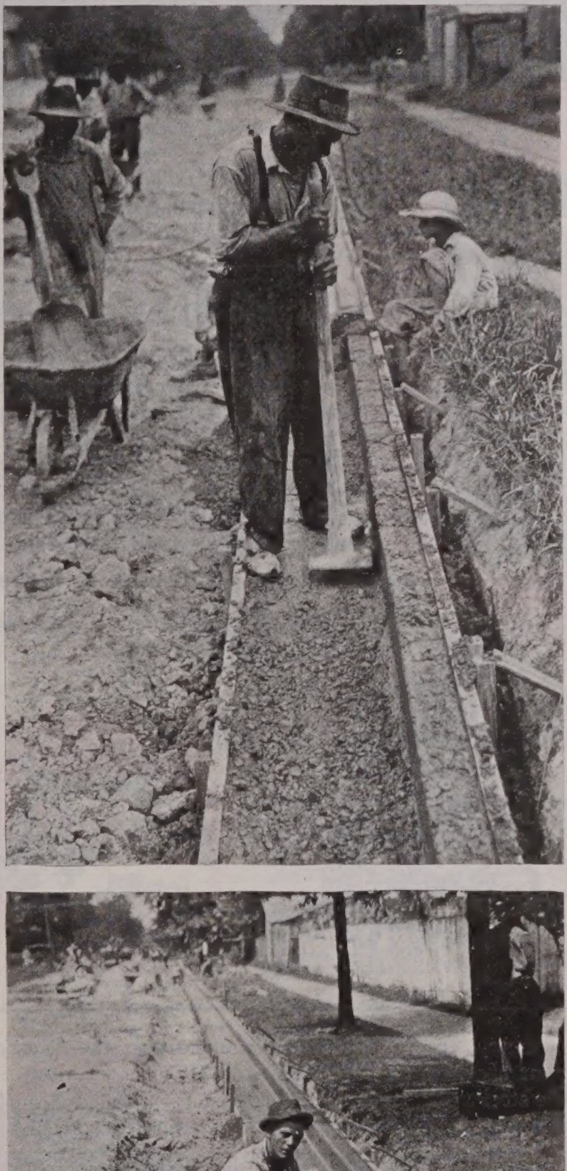
Letters are of art glass using white glass for the field and red glass for the letters. The glass panels are 3 ft. x 7 in. for the word Newberg and 1 ft. x 5 ft. for the word Welcome, in panels.

Four lights are evenly spaced behind the word Welcome and three behind the word Newberg and one in the main ball. Globes of 25 kw. were used for all signs and the main ball on top the pier.

Combined Curb and Gutter Work

Combined curb and gutter construction in Pine Bluff, Ark., is shown in the accompanying pictures.

With one exception, all Pine Bluff paving contracts let in the past six years have been for concrete, and property owners have found it equally satisfactory for new work or for replacing worn-out surfaces of other types. Harding Boulevard was the first street to have its dust and mud eliminated by a concrete surface. That was in 1915. Then, in 1921, the surface of the pavement on Olive Street became so bad that something had to be done with it, and it was resurfaced with concrete.



How combined curb and gutter work is done in Pine Bluff, Ark.

The specifications (Fred Bennett, consulting engineer) called for a 1:2:3 concrete surface with an average thickness of 4 in. The old base was so uneven however, that the actual thickness varied from 2 to 6 in. Wire mesh, weighing 30 lb. per 100 sq. ft., was used as reinforcement.

Before the old base was covered, it was scrubbed absolutely clean, and then there was brushed over it a thin cement-and-water grout, upon which the fresh concrete was deposited. After that, the new concrete was struck off, tamped, finished, and cured, the same as any ordinary concrete pavement.

This resurfacing job marked the beginning of Pine Bluff's paving program.

On all contracts a curb and gutter is built first, so that there will be something to work from in trimming the subgrade and striking off the pavement. This curb and gutter has a core of 1:2:4 concrete, topped with a ¾-in. 1:2 mortar surface. The concrete is first tamped into the forms to the proper level, then the curb face board is removed. After that, the first coat of mortar topping is put on and spread with a steel template or "mule," which rests on both front and back forms and molds the edges to the proper curves. The first coat is allowed to dry a little, then a very thin flush coat is spread on the same template, giving the surface a smooth finish without trowelling. The top coat is mixed in the mixer, but is run into a mortar box, where it is given exactly the right consistency for the two applications.

An expansion joint is put in every 50 ft. Between joints, the concrete is marked with an edger into 6-ft. blocks. Pavements are uniformly 6 in. of 1:2:3 concrete reinforced with Electric Weld mesh, weighing 32 lb. per 100 sq. ft. Widths vary from 21 to 30 ft.

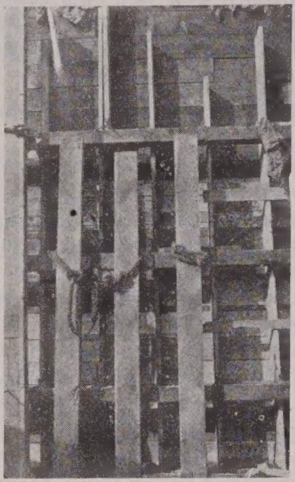
Ocean City Houses of Concrete Masonry

The picture shows concrete masonry houses included in the Ocean City, N. J., development recently undertaken by the Shissler Construction Co., Philadelphia. While the Shissler company felt that the time was ripe for building to begin, local conditions hardly justified the expense of brick construction. Pressure was brought to bear upon Mr. Shissler to reduce the cost by using frame construction, but since he is a firm believer in fire-safety and permanence, he would not hear of sacrificing these. Concrete masonry, stuccoed, offered a satisfactory solution of the problem, and it was therefore used.

The development called for 56 double houses, but improved conditions, and the ready sale of the houses which has been promoted by the use of concrete masonry, has warranted increasing this number to at least 110, and perhaps more. The first dozen houses were built along Bay avenue, between Fourth and Fifth streets. E. M. Kent is the builder, and the block were furnished by the Concrete Specialties Co., of Camden.

Bulking Effect of Celite

An interesting test on the bulking effect of Celite in concrete, recently made by McDonald & Kahn, Inc., large contractors in Los Angeles, is reported by the Celite Products Co. Previous tests have shown that Celite improves workability and gives a more uniform and dense concrete, but this test was for the purpose of determining whether the increased yield of concrete in place was sufficient, from the contractor's standpoint, to offset the cost of the Celite used.



The column in the center poured without Celite as an admixture. The columns on either side show the bulking effect due to the use of Celite

Forms were made out of 2-in. x 10-in. x 16-ft. planks, stood on end so that the concrete could be poured in from the top. A 1:2½:3½ mix was used, with coarse washed sand and ¾-in. stone. All materials were carefully measured in a cubic foot measuring box, 6.34 gals. of water were added to the dry mix, and a column of concrete was secured—10 ft. 11 in. in height.

In the next batch, the same amount of material and the same quantity of water was added, the only change being the addition of 3½ lb. of Celite. This mixture gave a column 11 ft. 6 in. in height, or an increase of 5.3% in the volume of concrete secured. The increased amount of concrete in place was more than enough to offset the cost of the Celite used. The results of these tests agree very closely with field tests made on Delaware and North Carolina State paving projects.

In the illustration, the column of plain concrete is shown in the center; the columns on either side contain Celite as an admixture.

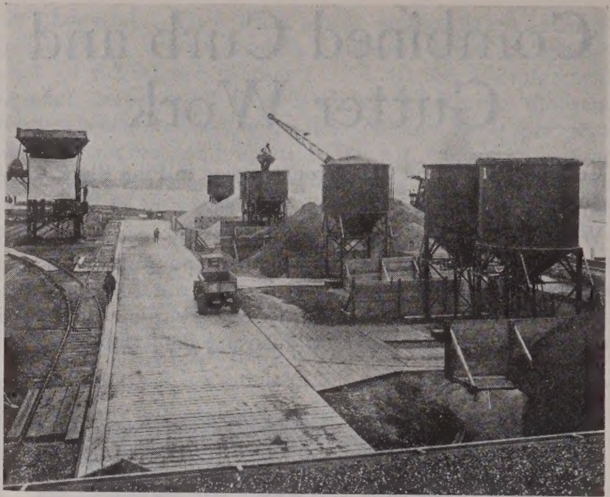
Blaw-Knox Circular Bins

The accompanying illustration shows an interesting installation of Blaw-Knox circular steel storage bins at the Spokane Ave. plant of the Pioneer Sand and Gravel Co., at Seattle, Washington.

Steel bins have been adopted here as standard equipment for a number of reasons: for the additional space gained by the method of installation; loss of dead storage; ease of operation; saving in labor as the driver controls the delivery of material from the bin to his truck without leaving his seat.

This plant of the Pioneer Sand and Gravel Co. covers approximately 300 ft. of water-front and is 400 ft. deep. There is a circular railroad track laid around the plant. Scows come in from the Sound, load alongside the dock and the material is handled from the scows to the circular bins or the ground storage. The location of each bin is adjacent to its own ground storage so that recharging operations are as efficient as possible.

The locomotive crane used in handling material is a Link-Belt 25-ton and the bucket is a 1¼-yd. Blaw-Knox speedster. The delivery of this plant at the present time is about 1,000 yds. every day exclusive of the central mixing concrete plant.



Installation of Blaw-Knox circular steel storage bins

The bin sizes are as follows: two circular steel bins, 85-ton capacity and four circular steel bins, 135-ton capacity.

New Portable Mixers

The Boss trail-bagger shown has found wide favor with telephone companies, street railway companies, and municipal gas companies, since extreme portability is of primary importance in the construction work of such firms.

Those who have tried will appreciate the difficulty of putting in two concrete jobs twenty or so miles apart, on the same day with ordinary equipment. This the Boss trail-bagger does every working day of the year and in almost every state in the country, according to the manufacturers, the American Cement Machine Co., Keokuk, Iowa.

The Boss trail-bagger mixer

The steel truck, as well as its compact construction, makes this mixer extremely portable. The two-wheel truck has solid rubber tires and roller-bearing wheels, which, with the wishbone lift hitch giving 10-in. road clearance, makes it possible to attach the trail-bagger to any truck and to tow it at any speed without whipping.

All steel construction has reduced the weight over 1000 lb., while maintaining ample capacity and durability. It is equipped with either power loader or low charger.

Jacklift and Stacker Practice 1925, an annual publication of the Lewis-Shepard Co., 128 Walnut Street, Watertown Station, Boston, Mass., presents a great many illustrations with brief descriptive text, showing the numerous applications of Jacklift trucks and stacking equipment in handling concrete products of all sorts in the cement and concrete field, and other products and packages in many other fields.

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Trade Publications

The University of Michigan has just sent out an announcement of the program in Chemical Engineering and of the Graduate Courses in General Chemical Engineering, Metallurgical Engineering, Gas Engineering and Organic Chemical Industries. The program gives some general information relative to the University of Michigan at Ann Arbor, Mich., also admission requirements and describes facilities for instruction and research.

In addition to the general laboratories described in the program, small laboratories are equipped for special work as follows: The cement laboratory is equipped with a small rotary kiln and other apparatus for burning portland cement under controlled conditions, and for testing the properties of cement; the ceramic laboratories consist of a kiln room, preparation room and laboratory. There are also special pulp and paper laboratories, stain and varnish laboratories, petroleum and motor fuel laboratories, electrochemical engineering laboratories, gas engineering laboratories and gas and fuel laboratories.

The Republic Flow Meters Co., Chicago, Ill., has issued an attractive pyrometer catalog containing much information of value to anyone interested in the general problem of heat measurement. The catalog is 8½ in. x 11 in., contains 56 pages and is attractively illustrated.

Among the numerous pyrometer applications mentioned are cement kilns, ceramic industries, chemical plants, gas plants, power plants, etc. In connection with the application to cement kilns, it is pointed out that records of temperature at the stack end of the kiln show whether the fuel is burning properly and also certain abnormalities of kiln operation such as the stopping of the kiln or the fuel, the appearance of rings and the flooding of fuel.

Speed and Power is the title of a booklet just published by the Boston Gear Works Sales Co., Norfolk Downs, Mass., describing standard reduction units for economical power transmission. The booklet is 3½ in. x 6 in. with paper covers and contains 24 pages of data and illustrations relative to the Boston speed reduction units.

The various types of units mentioned include: those equipped with double Helical gears for the first reduction and single helical gears for the second reduction and worm gear type equipped with phosphor bronze worm gears and hardened steel worms with threads ground. The speed reduction units shown in the booklet are only some of the large Boston gear family, there being 3000 sizes of styles totaling over a half million gears, stocked, ready for immediate delivery at all times.

American Sirocco Fans and Blowers is the title of Bulletin 1801, issued by the American Blower Co., Detroit, Mich., superseding Bulletin 1, series 8. This bulletin is 8½ in. x 11 in., 72 pages, illustrated and contains a brief description of the mechanical construction of the fan, together with complete capacity and dimension tables for the engineer's use.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 1807 East Grand Boulevard, Detroit.

American Concrete Pipe Association; M. W. Loving, Secretary, 111 West Washington St., Chicago.

American Engineering Standards Committee; Dr. P. G. Agne, Secretary, 29 W. Thirty-ninth Street, New York City.

Associated General Contractors of America; G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; 123 W. Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference; Rudolph P. Miller, President, Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary. 160 North La Salle Street, Chicago.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Iowa Concrete Products Association; Ross Dowell, Secretary, 405 Hubbell Bldg., Des Moines.

Mid-West Concrete Products Association; D. R. Donlen, Secretary-Treasurer, 4340 Marcy St., Omaha, Neb.

National Association of Manufacturers; John E. Edgerton, President; Henry Abbott, Treasurer; George S. Boudinot, Secretary, 50 Church St., New York City.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High Street, Columbus, Ohio.

National Crushed Stone Association; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East 22nd St., New York City.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

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